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AUTOMOTIVE and Aviation INDUSTRIES

SEPTEMBER 15, 1942

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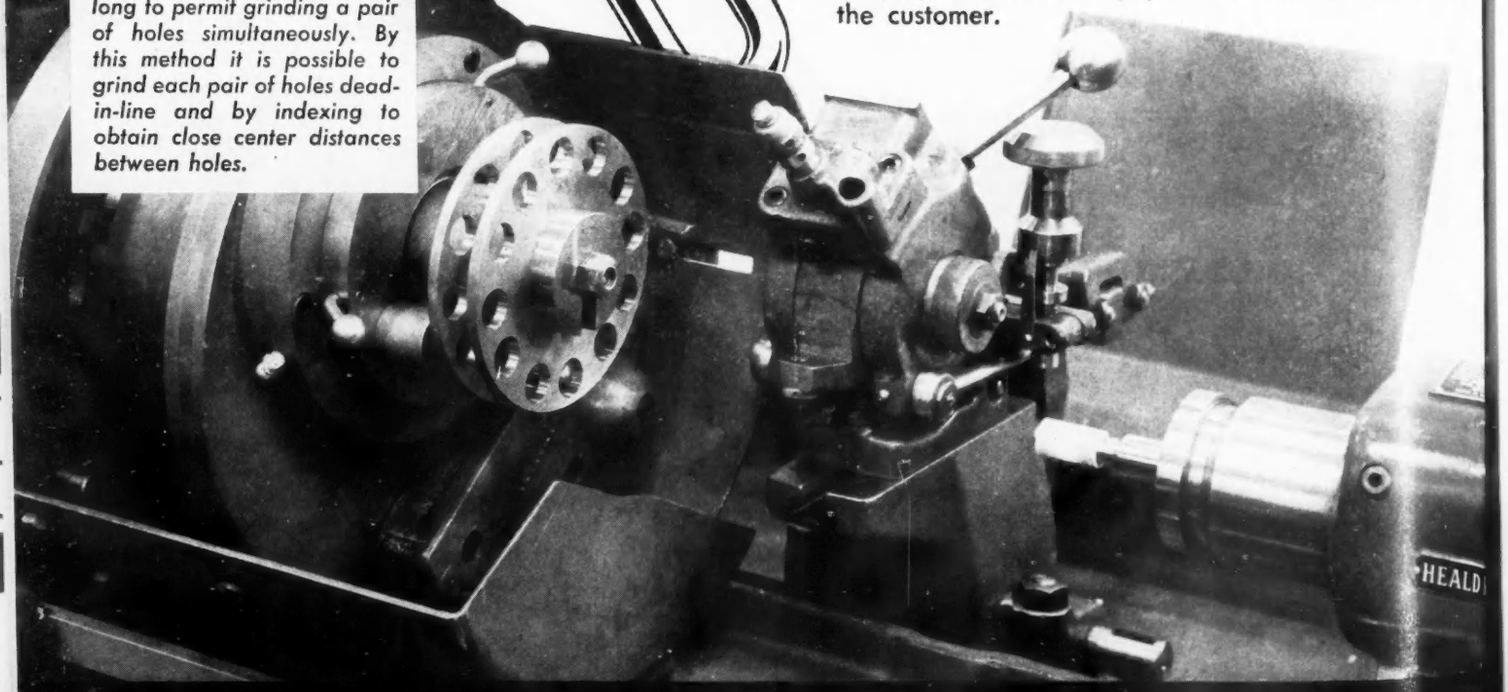

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AUTOMOTIVE and Aviation INDUSTRIES

Published Semi-Monthly

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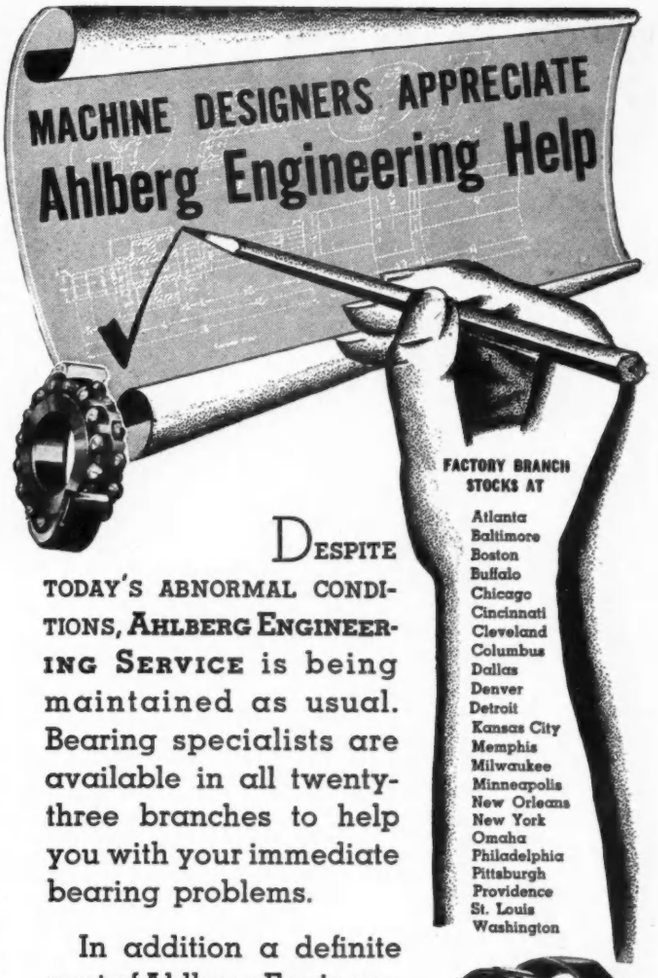

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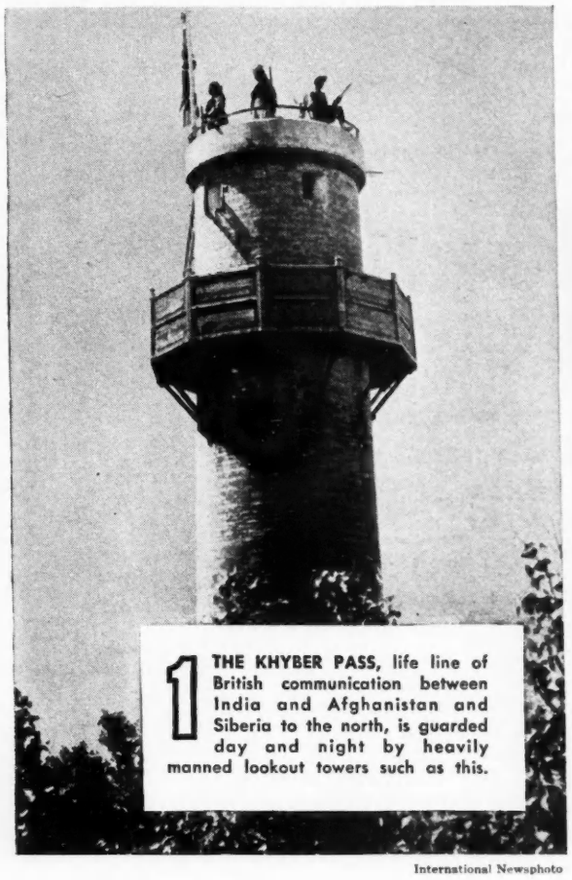

1 **THE KHYBER PASS,** life line of British communication between India and Afghanistan and Siberia to the north, is guarded day and night by heavily manned lookout towers such as this.

International Newsphoto

2 **U. S. ARMY EXPEDITIONARY GAS CANS,** used by the hundreds of thousands wherever there are gas propelled military vehicles, tanks or aircraft, have their life lines —their air vent tubes—of Bundy Tubing.

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IN THIS ISSUE . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 87 Sept. 15, 1942 Number 6

Michigan Leads in War Contracts 17

Did you know that nearly seven and one-half millions of dollars' worth of war contracts have been awarded to Michigan organizations?

Did you know that New York was a close second? Do you know where all of the war dollars are being spent? Read this article.

Production of Jeeps, Shells and Forgings 20

At the Willys plant there has been a lot of things accomplished in going all-out for war production. The Hows and Whats of it all make a most enlightening story.

Jet Propulsion Developments 30

This system of powering airplanes takes one back to the days when we had rockets for the Fourth of July. Patents were taken out by G. Caproni in 1934. The success of tests made and other developments in this field make it a very probable "may be" for future power in aircraft.

The Focke Wulf FW 190 34

Although these German planes have been more or less prevalent in the air over combat areas it has only now been learned just how it ticks. Here is a description augmented with pictures.

Production Problems Due to War 36

In this period of all-out endeavor many new and difficult circumstances have risen. Just how the Pierce Governor Co. met their problems makes interesting reading.

Heliarc Welding 40

A new method of arc-welding applicable to magnesium sheets, extruded sections and tubing has been developed and made available to the war industries. Keep up to the minute and read this description.

The Potez 161 48

A French plane of real interest although its manufacture has been held in abeyance.

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

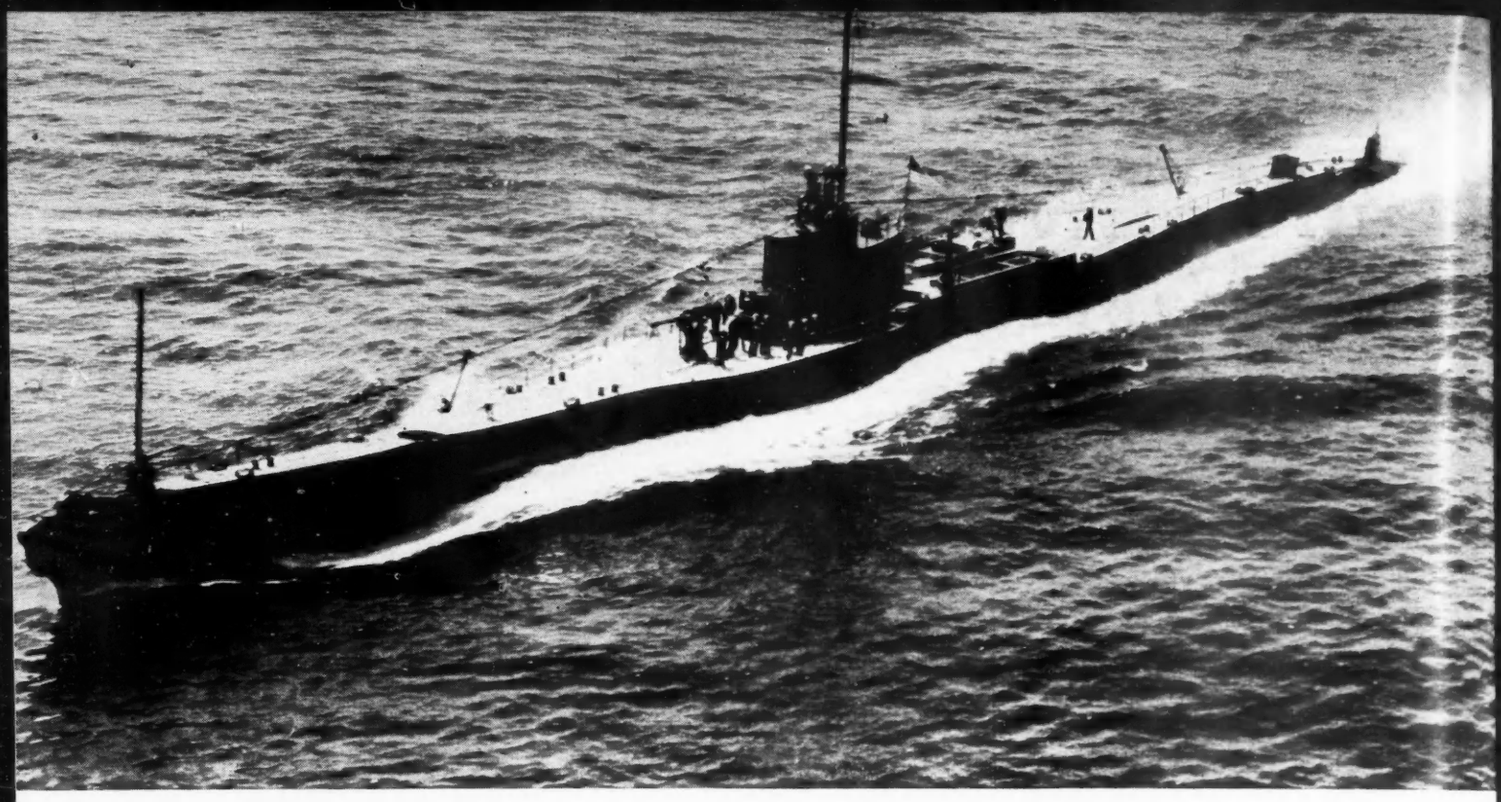
Automobile Mortality Twice That of Humans

Mortality of automobiles in the United States during the past few years has been approximately double that of humans, and the number of automobile "graveyards" at the beginning of 1942 was approximately twice the number of active large cemeteries, or public burial grounds in the United States, figures compiled by the Automobile Manufacturers Association and the U. S. Bureau of Census disclose.

In recent years human deaths in the United States have been about one and one-third million; motor vehicles retired from service, on the other hand, have been approximately twice as great, standing at about 2,600,000 annually from 1939 to 1941.

At the end of 1941 there were 20,393 automobile "graveyards" in the United States, containing 918,000 junk cars. Active public burial grounds, not counting the numerous but relatively inactive church burial plots, are estimated at approximately 8,000 for the United States. During the past few months many automobile "graveyards" have disappeared in the nation-wide drive for scrap metals.

The birth rate of motor vehicles in the United States during 1939 through 1941 has averaged in excess of 4,000,000 annually, or nearly twice the yearly average number of births in the population.



Sub Propeller Shafts Needed Quickly!

Story of How Ryerson Ingenuity Saved Five Weeks

URGENTLY needed at a distant shipyard were fourteen forged submarine propeller shafts that must pass Navy specifications.

Forgings were specified, but none could be secured in time.

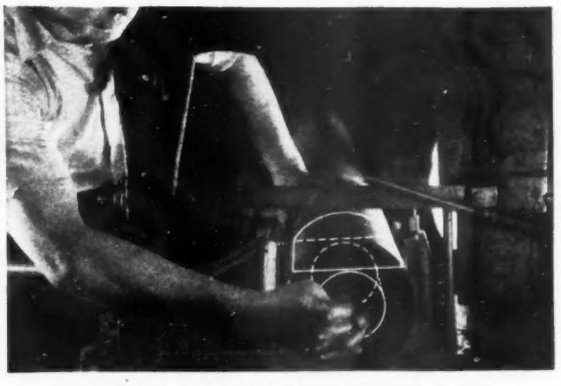
Quickly available in Ryerson stocks were cold rolled bars—the right size—but in five different analyses.

Navy Inspectors were skeptical. Could Ryerson heat-treat and assure uniform physicals—also furnish pull tests for each bar? Well, no; because the piece left after the bars were cut to the needed length, would be too short to make a standard 6″ test sample. A delay of five weeks loomed ahead. . . .

Then Ryerson metallurgists found a way: Inquiry revealed that the shafts were to be machined down at each end for a distance of 7″. So, why not cut a piece from the side of each bar, *before machining*—enough for all tests yet leaving sufficient stock for machining to size? The idea worked perfectly.

The data charts always furnished with Ryerson Certified Steels provided the exact analysis of each bar and assured proper heat-treatment. A few minutes hacksaw work yielded the necessary test samples . . . and all fourteen bars passed the rigid Navy Inspection with flying colors.

Ryerson ingenuity has helped many manufacturers in solving production problems—has also cut ultimate delivery time from months to days. Ryerson engineers and metallurgists, backed by a century of service to the nation, are ready to work with you in accordance with WPB plan in making the most of all available steel.



Cutting 6″ test pieces from side of bar without affecting length.

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

Vol. 87, No. 6
September 15, 1942

Michigan Leads in Major War Contracts

WPB Report Reveals Large Number of Automotive Plants Throughout Nation Now Engaged in Armament Production

EVIDENCE that the automotive industry is contributing a major share to the war production effort is contained in a report by the War Production Board on the distribution of all major war supply and plant contracts from the inception of the national defense program to June 30, 1942. Such contracts totaled $80,338,688,000, with Michigan, center of the automotive industry, standing first with $7,417,140, or 9.2 per cent of the total. Michigan has 65 motor vehicle plants and 214 automotive parts plants making war goods, according to a survey by the Automobile Manufacturers Association.

Second on the war contract list was New York with $6,980,332,000 in commitments, or 8.7 per cent of the total. New York's automotive plants engaged in war work are 92 in number, standing fourth in the nation in that respect. California, with huge aircraft contracts, ranked third in war orders with $6,944,119,000, or 8.6 per cent of the national total. California has 35 automotive plants in war production being No. 8 on the list. Ohio, second to Michigan in automotive plants holding war contracts with 145 factories so engaged, is fourth in total contracts with $5,321,506,000, or 6.6 per cent of the national figure.

In fifth place on the war production table is Pennsylvania with $4,629,240,000 in orders, which amount to 4.8 per cent. Pennsylvania's automotive plants in war work number 53. New Jersey is sixth with $4,407,079,000, which is 5.5 per cent of the total, and has 31 automotive plants turning out armaments. Connecticut has $3,252,734,000 in war orders, 4.5 per cent, and lists 24 automotive plants holding war contracts. Illinois ranks eighth in arms orders with $3,243,123,000, or 4.4 per cent, but is third among the states in war-producing automotive factories with an even 100 so engaged.

Indiana, which has 75 automotive plants working on war orders, holds $2,727,848,000 in war contracts, 3.4 per cent of the national total. Wisconsin's 48 automotive plants engaged in war production hold some of that state's $1,429,660,000 in armament orders, which amount to 1.8 per cent of the national total. Missouri has 24 automotive plants producing armaments and lists $1,367,545,000 in war contracts, which is 1.7 per cent of the total. North Dakota is last on the list of war contracts with $2,743,000 in orders and has one automotive plant so engaged. Seventeen of the 48 states are without automotive plants working on war production.

By E. L. Warner, Jr.

The compilation of war contracts by WPB did not include Army letters of intent, orders placed with arsenals, foodstuffs, service pay and subsistence, budget requisitions of the Navy and contracts of less than $50,000. Including such classifications, the war expenditures up to June 30 totaled $129,998,000,000. A compilation by the Treasury Department reveals that total appropriations and contract authorizations for the war program are approximately $214,759,000,000 as of Aug. 15. Total expenditures from June, 1940, to Aug. 15, 1942, are estimated at $42,067,000,000. Appropriations and contracts for airplanes total $45,500,000,000 and for ordnance they total $45,053,000,000. Miscellaneous munitions total $32,658,000,000 and naval ships aggregate $18,460,000,000. August war expenditures set a record high of $4,882,498,435 or approximately $158,000,000 per day.

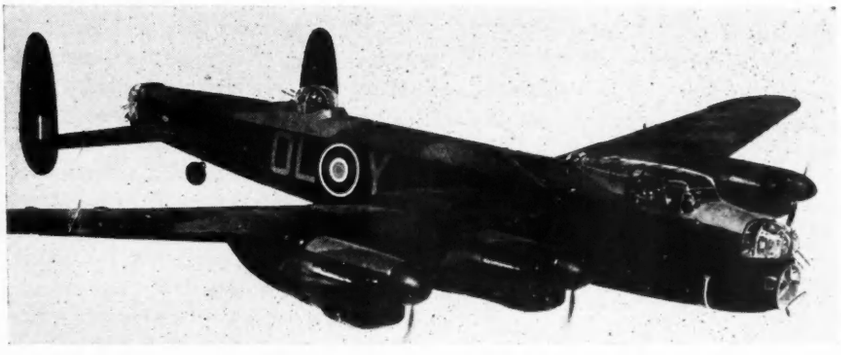
(*Turn to page 70, please*)

The Avro-L

OF BRITAIN'S line of heavy bombers, the Avro-Lancaster is the latest and most devastating addition. Its designers and manufacturers are A. V. Roe and Co., one of Britain's earliest and foremost aircraft companies. It succeeds a long line of famous machines, the most recent of them being the Anson and the Manchester. Actually, the Lancaster is based on the Manchester design and resembles that warplane in many respects, though the Manchester, it may be recalled, has two Rolls-Royce 24-cylinder Vulture engines (see AUTOMOTIVE and AVIATION INDUSTRIES of July 15, page 23), whereas the Lancaster is powered by four engines, usually the Rolls-Royce Merlin XX. Other engines, including the Bristol Hercules 14-cylinder sleeve valve radial, are being fitted as well.

The Lancaster is in large-scale production in many plants of the Avro group and also at those of other British aircraft manufacturers. It is also being produced in Canada.

In type it is a mid-wing all-metal cantilever monoplane, with retractable undercarriage. The wing span is 102 ft, length 69 ft 4 in., height 20 ft and gross wing area 1297 sq ft. The fuselage is 8 ft 2 in. deep and 5 ft 9 in. wide. The bomb compartment in the fuselage is 33 ft long. The main wheels of the undercarriage are 5 ft 6 in. in diameter. Under operating conditions the machine weighs approximately 67,200 lb when fully loaded. It has a maximum speed of about 300 mph and a range of approximately 3000 miles. The maximum bomb load is around 17,600 lb. Armament consists of ten .303 caliber Browning guns mounted in four turrets—in the nose, above the fuselage, under the fuselage and in the tail. A crew of seven can be carried.



The Lancaster in flight. Note the simplified form of the fuselage.

Advantages of the design are claimed to be ease of production, of transport and of maintenance and repair, owing to the machine being built-up of numerous separate and self-contained units with 100 per cent interchangeability. Constructional features have been simplified to the utmost, it is contended.

The fuselage is built of transverse formers with continuous longitudinal stringers, while the main wing is of two-spar construction, each spar consisting of top and bottom extruded booms bolted to a single web plate of heavy gage. The wing ribs are aluminum alloy stampings, flanged and swaged for stiffness. The tail plane is built up in a similar manner to the wing, with twin fins and rudders. The skin plating throughout consists of aluminum alloy sheets with flush rivetting. Retracting inside the inboard engine nacelles, the undercarriage is operated hydraulically.

Fuel is carried in six self-sealing tanks in the wings, which are fitted with de-icing equipment. A rubber emergency boat is carried in the center section trailing edge portion of the wing and is automatically operated in a crash landing, though it can also be operated by hand.

From the pilot's cockpit an excellent view is obtained in almost all directions. Under the same canopy, is the fight controller's position, also with an excellent range of view. Slightly aft is the navigator's position, with table, stowage for charts and an astral dome in the roof. The radio operator's station is at the rear end of the navigator's table, just forward of the front spar. An armor-plated bulkhead is fitted across the center section portion of the fuselage at this point, and is so arranged that it will open up for access on either side of the center line.

The back of the pilot's seat is also armor plated, and there is armor plate protection behind his head. Certain other vulernable parts of the aircraft and of the turrets are also armor plated, while at the fight controller's position bullet proof glass is provided to give additional protection.

Within the fuselage center section oxygen bottles are stowed in a crate, the cover of which is upholstered and provides a comfortable couch with an adjustable back-rest. In the fuselage aft of the rear spar a mid upper turret and mid under turret are fitted, together with various equipment stowages for flares, emergency rations, flasks, etc. The ammunition boxes are located in this portion of the fuselage

The nose of the Lancaster showing the pilot's nacelle, the front turret and the bomb aimer's window.

By
M. W. Bourdon

Special Correspondent of AUTOMOTIVE *and* AVIATION INDUSTRIES in Great Britain.

Lancaster, *Britain's Newest Heavy Bomber*

and ammunition is carried to the tail turret by tracks.

A walk is provided along the entire length of the fuselage. The main entrance door is on the starboard side just forward of the tailplane, and at suitable points escape hatches are provided for all members of the crew.

The bomb aimer's station is in the nose of the machine, below the front turret. The bomb compartment is contained within the fuselage form, and the floor above it, which is of strong construction and constitutes the backbone of the fuselage, accommodates housing for the various types of bombs employed. Two large doors are fitted to the compartment and these are operated hydraulically. A point of note in connection with the bomb doors is that the electrical circuits are so designed that the bombs cannot be released until the bomb doors are open. In cases of emergency or failure of the hydraulic system, the bomb doors can be opened by an emergency air system. This applies also to the under-carriage. Oxygen points and stowages for parachutes are provided at all crew stations.

Already, in the short period during which it has been employed, the Lancaster has been used on night raids to bomb Cologne, Essen and other industrial centers in the Ruhr. By day, it carried out the epic raid on Augsburg and the raids on Danzig, Flensburg and other Baltic ports.

Powered by four Rolls - Royce Merlin XX engines, the Lancaster is capable of carrying over 8½ tons of bombs.

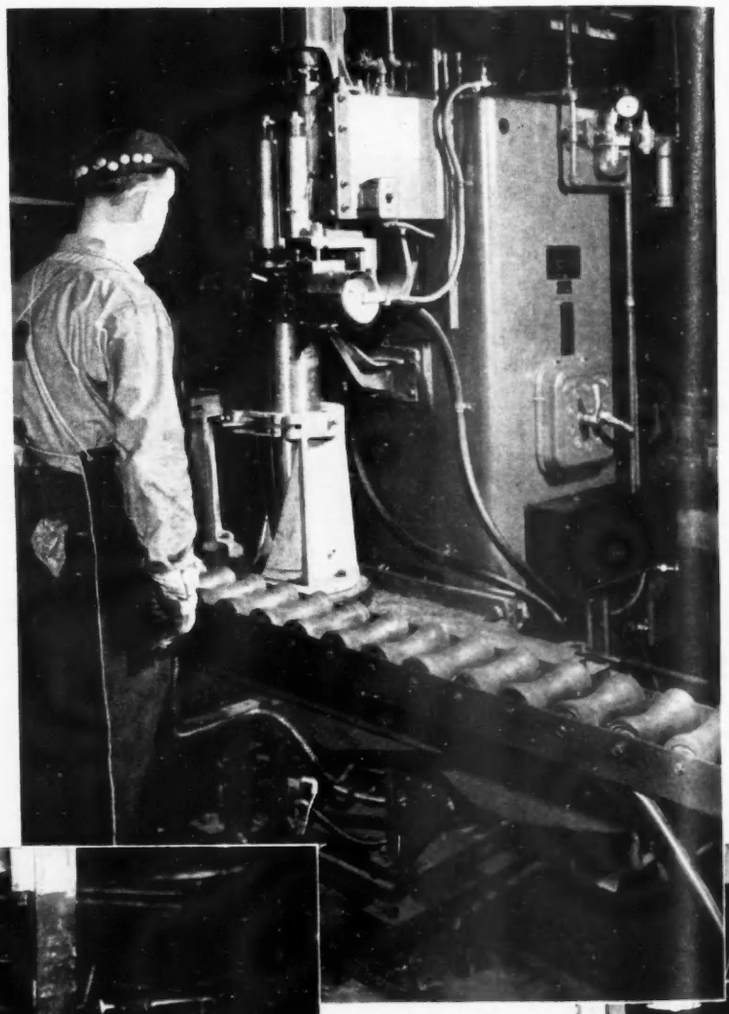
Production of

Jeeps, Shells a

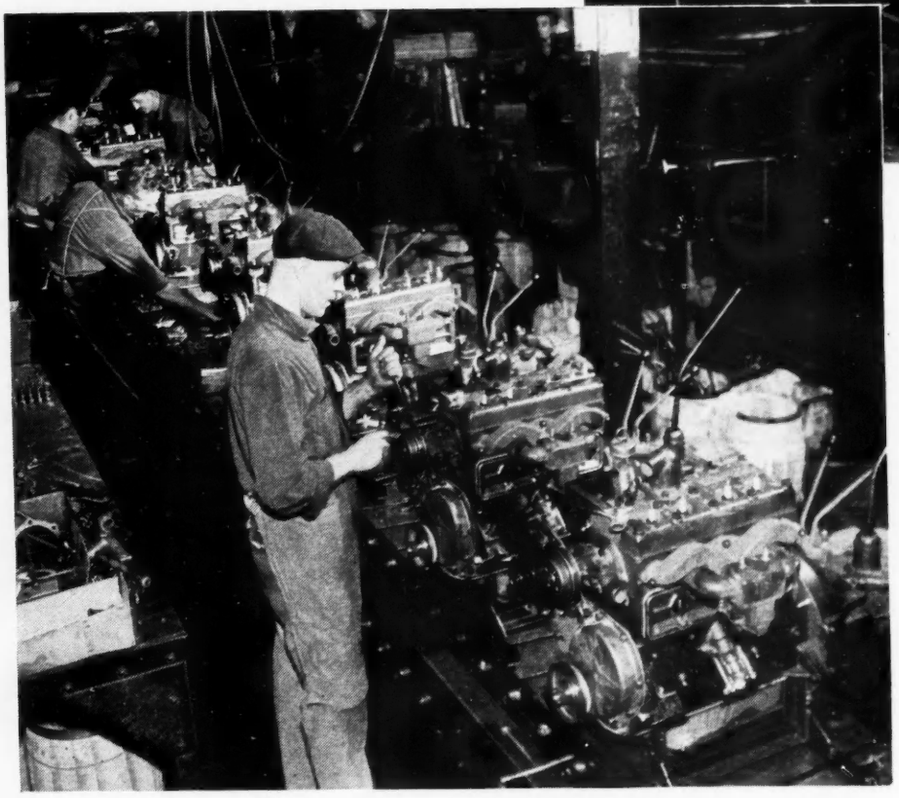
By Joseph Geschelin

FROM the making of Americars—the lowest priced transportation units in this country before the war—to mass production of Jeeps for the Army, that's only part of the story of the war effort of Willys-Overland Motors, Inc. In addition to the Jeeps, Willys is in full production on shells of various sizes. The forge shop, one of the larger units of the industry, is busy making forgings both of steel and aluminum.

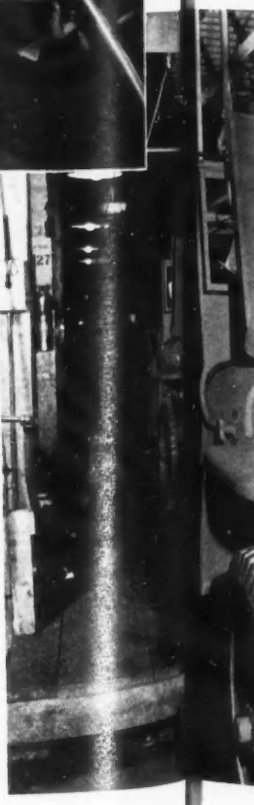
In many ways, the Willys organization reflects great credit on the managerial abilities of Joseph W. Frazer, its president, and his associates through whose efforts the company was so thoroughly rehabili-



(Right) Thomson-Gibb resistance welder, one of a battery employed for the seam welding of the protective steel plate on the closed end of the shell.



(Left) Final assembly line for Jeep engines at Willys is reminiscent of the peace-time activity of the passenger car builders, except for greatly accelerated pace.



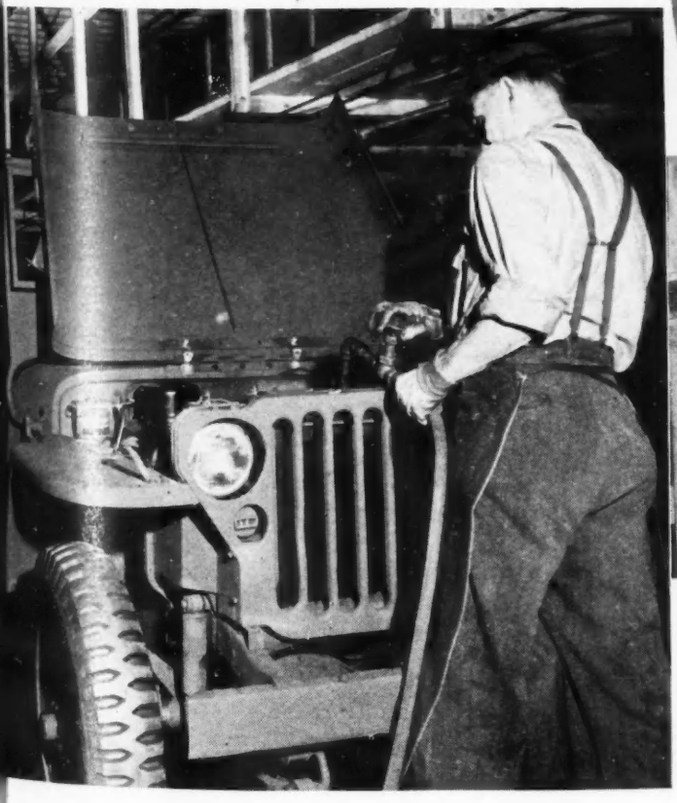
and Forgings

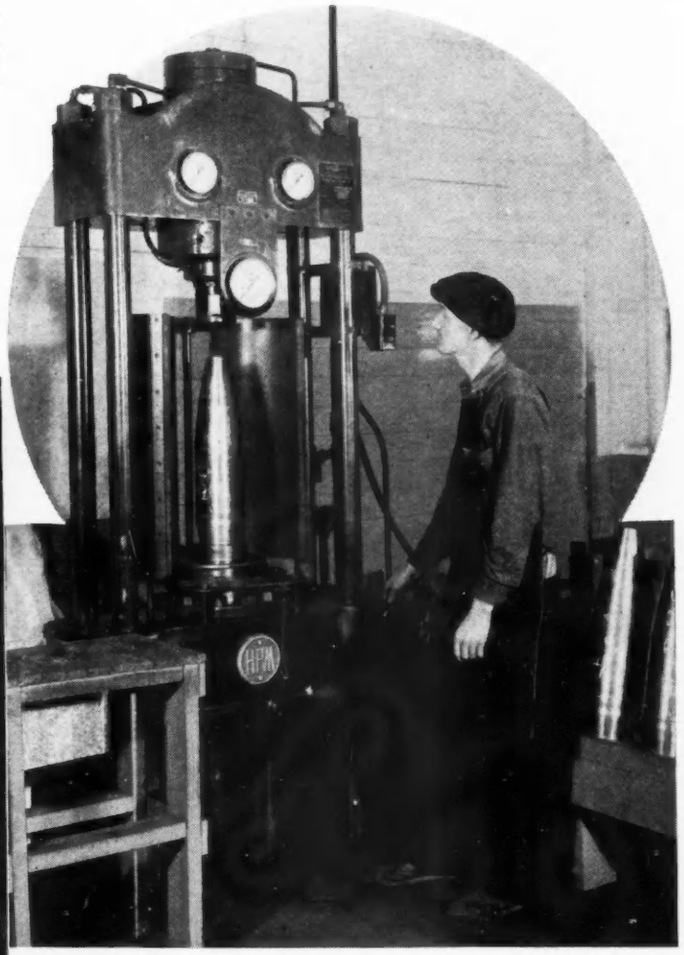
at the Willys Plant

tated. Needless to say, the ability to build Jeeps for the Army stems directly from the fact that Willys had been building the Americar in mass production and had the facilities and know-how to proceed on the war contract without delay. The expanding war program finds Willys in an excellent position to take on additional projects since the plant is gifted with a great expanse of floor space which has been unused for many years.

The shift from Americars to Jeeps certainly was not a difficult one to make. As a matter of fact, since the little car is essentially an automotive unit, it involves less complication in the scheduling and on the assembly lines than does the motor car due to the absence of the options as to body styles, paint, upholstery, and the other special details involved in a passenger car program. The Jeep is an assembly proposition since many of the major elements such as transmissions, axles, transfer cases, drive elements, and machined parts are purchased from outside sub-contractors. However, the engine is integrated completely in the Willys plant. Parts such as the crankshaft and camshaft are machined here in the former departments while the engine is assembled on the conventional assembly line.

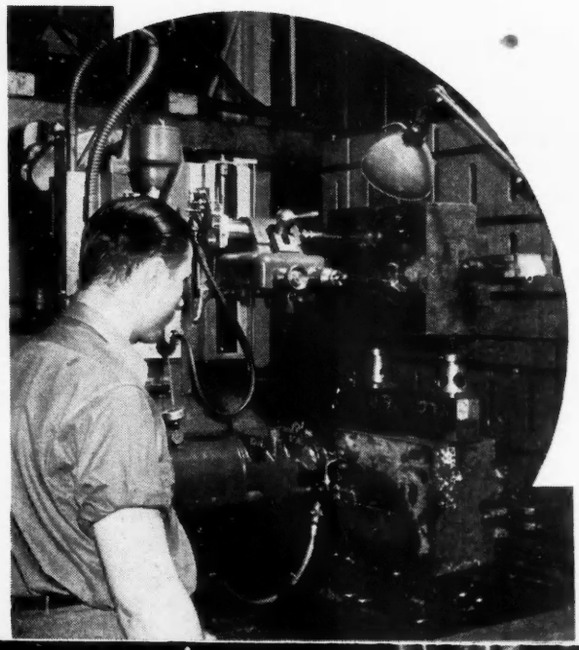
Vehicle assembly operations begin with the usual chassis line on which the running gear components are integrated. Engines come in on an overhead monorail conveyor. Before the chassis reaches the body drop, it goes through spray booths built right into the

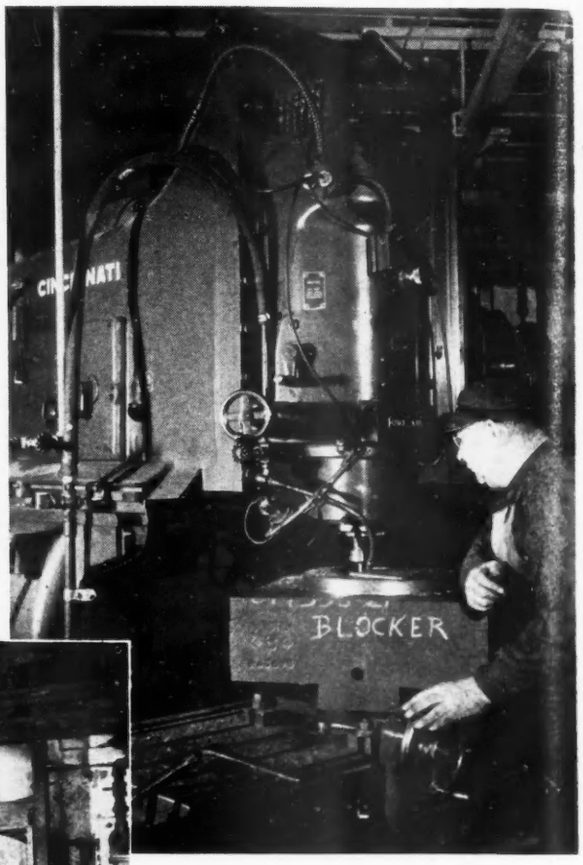




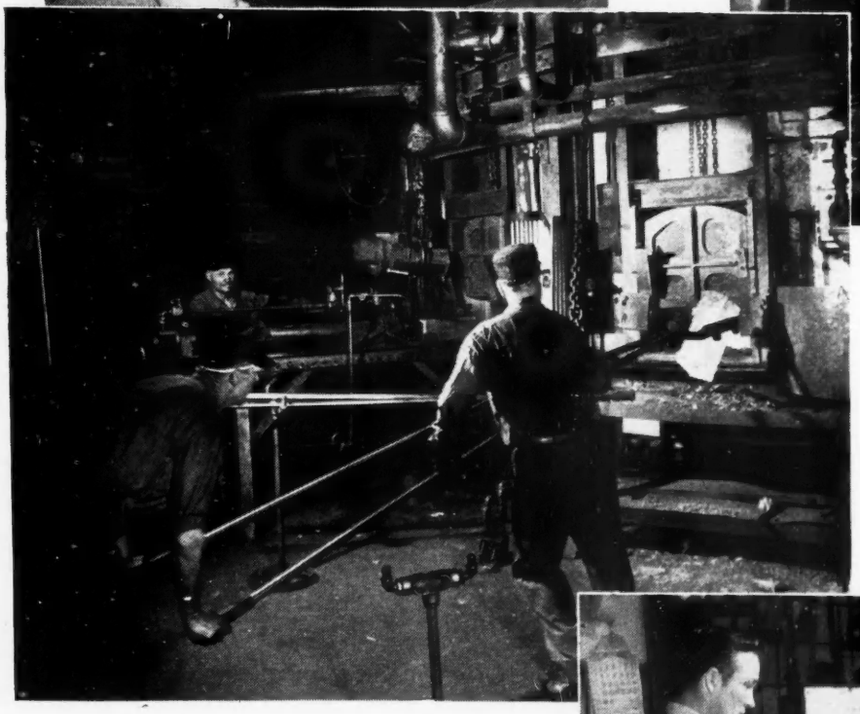
(Above) At the discretion of the inspector, doubtful shells are tested for soundness under suitable internal hydrostatic pressure on the special testing machine developed by H-P-M.

(Left) Coming to the end of the Jeep assembly line at Willys.





(Above) This Cincinnati die-sinker is a new piece of equipment recently installed in the Willys tool room.

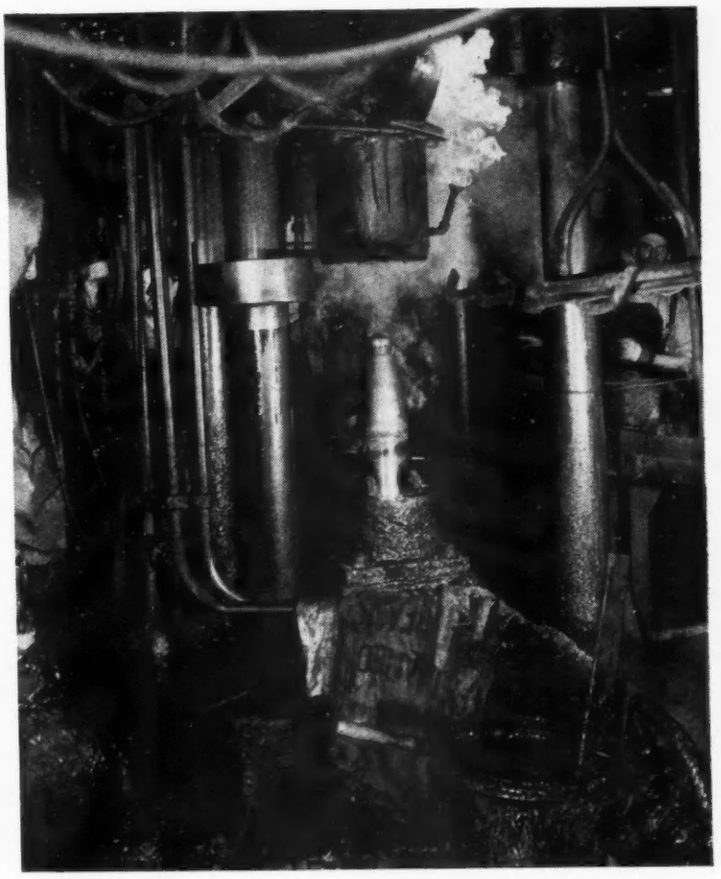


(Above) Billets for the large shell bodies are heated in this huge rotary Surface Combustion furnace prior to rough blanking and piercing on Elmes vertical presses that serve the horizontal draw bench.

(Top left) New Pratt & Whitney Keller die-sinking machine recently installed in the Willys tool room.

(Right) One of a large battery of New Britain-Gridley automatic screw machines that make up the bulk of the equipment in the small AA shell department. Shell blanks are turned directly from bar stock in these machines.

Close-up of big Watson-Stillman hydraulic hot-nosing press used for nosing shells produced by Willys.



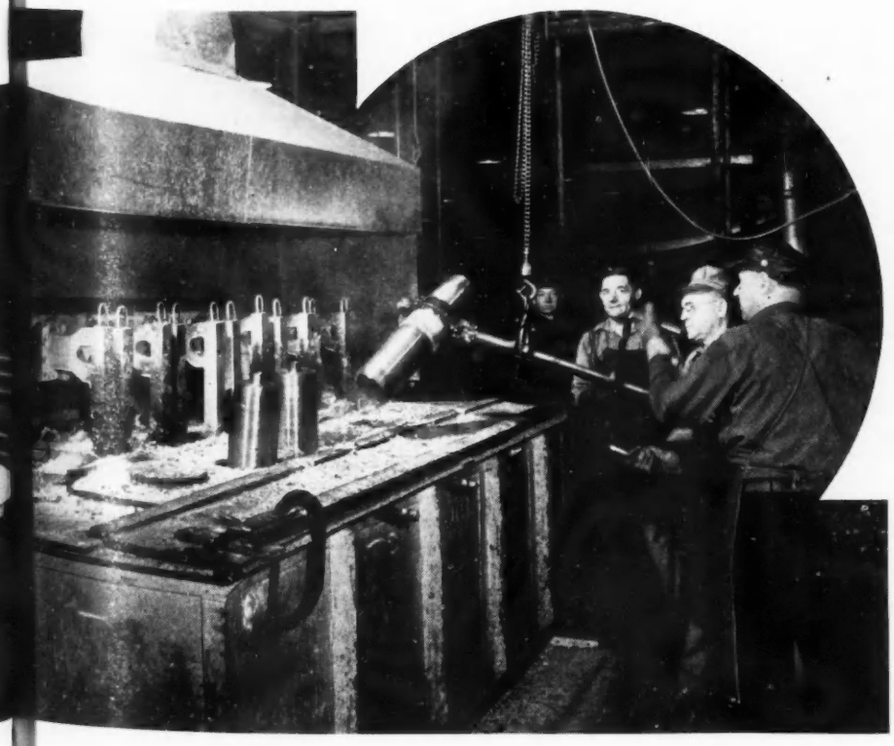
assembly conveyor line. Here the chassis is painted to Army specifications, dried while in motion in an infra-red lamp baking oven. From this point on the vehicle proceeds along the final assembly line. Bodies are lowered through an opening from the floor above; other sheet metal parts are attached in proper sequence. Final assembly is followed by inspection and tests for acceptance by the Army before shipment. Generally speaking, except for the larger quantities involved, this operation corresponds to the peace-time activity of building the Americar.

The forge shop presents an entirely different picture. For one thing, it has been split up into two major sections. The older section is devoted to the making of steel forgings including connecting rods and crankshafts for Jeep engines, special turnbuckles, and other parts. It has been supplemented with new equipment for the forging of large shells. The aluminum forging department boasts some new steam hammers and trim presses and is moving full speed ahead on the production of a wide variety of aluminum forgings.

The aluminum department has a large battery of Erie steel hammers, both old and new, and a number of new Toledo trimming presses. All of the aluminum forgings must be heat treated before machining and this is done in a battery of new Surface Combustion Co. furnaces. This department, too, has been supplemented with a cleaning room for bench operations of trimming, burring, and grinding of aluminum parts. These benches are fitted with the new Kellerflex portable tools for handling the various finishing operations.

The steel forging division retains its older steam hammers, mostly made by Erie, some by Chambersburg. All of the hammers are served by Surface Combustion Co. billet heating furnaces. In addition to turning out the familiar connecting rods and crankshafts this department is making many parts for the war program. One of the principal sections of the steel forge shop has been set aside for making large shell bodies.

Willys makes large shell forgings by the draw bench process. Billets are heated in large, multiple-station Surface Combustion rotary furnaces,



This modern Ajax salt-bath furnace heats the nose end of shells in preparation for the hot nosing on the Watson-Stillman press at the right.

Willys has a large department adjacent to the aluminum forge shop for handling the gamut of grinding, burring, and polishing operations on aluminum forgings. This is a close-up of one of the work stations.

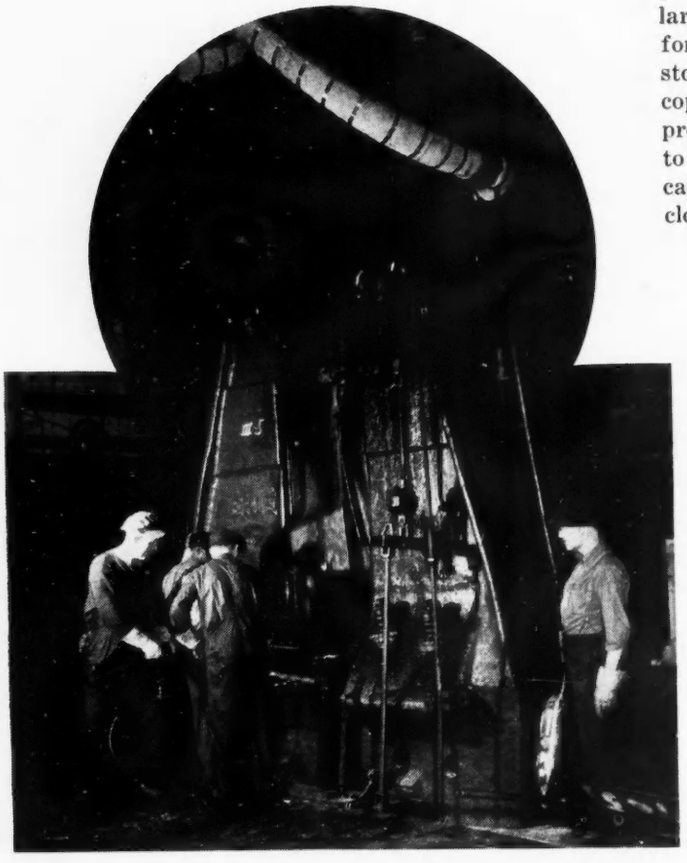
then are processed through various items of Elmes equipment. First operation is that of descaling in a special Elmes press, followed by piercing in an adjoining Elmes press. The shell then is formed in an Elmes draw bench in which the forging is pushed successively through a series of six sizing rings. From this machine the shell bodies are loaded onto a gravity roller conveyor and pushed down to a long cooling conveyor. The shell forgings then are transported to the cleaning department where they are shot blasted in Pangborn machines. Following this, they are loaded onto a new monorail conveyor for transportation to the machine shop.

A very busy die room serves the forge shops. It has been increased in size and recently its facilities have been enhanced by the acquisition of modern die shop equipment including two of the latest Cincinnati Hydro-Tel machines for die-sinking, a Keller automatic die-sintering machine, and the familiar Blanchard surface grinder.

Coming to the machine shops, we find a department devoted to the fabrication of shell nose pieces, featuring a large battery of the towering Bullard Mult-Au-Matics. The other principal machine shop centers are going night and day producing shells.

The smaller shell department is a small replica of the facilities for making large shells with many parallel operations. Principal equipment here is a large battery of New Britain-Gridley screw machines for machining the shell body completely from bar stock. These small shells are suitably grooved for the copper band and are banded in a fashion similar to the procedure on large shells. The band then is machined to size. It is of interest to find that the latest practice calls for the seam welding of a small steel disk on the closed end following the same practice as on the larger shells. After the shells have been finished and inspected they are moved on to the paint station. Here they are mounted on pivoted supports on a merry-go-round table conveyor which is a part of the DeVilbiss automatic paint spraying machine. The paint is dried by passing through an infra-red lamp baking oven.

No doubt the largest machine shop department at this writing is the one devoted to the processing of artillery shells. Principal turning equipment here has been supplied by Curtis, Stamets, and Hepburn (Canada). The first operation preparatory to metal cutting is that of centering in a battery of new vertical type machines. Rough turning is handled on a large battery of Curtis automatic lathes and a bat-



One of the big Erie steam hammers in the Willys forge shop. This is one of the largest forge shops in the industry.

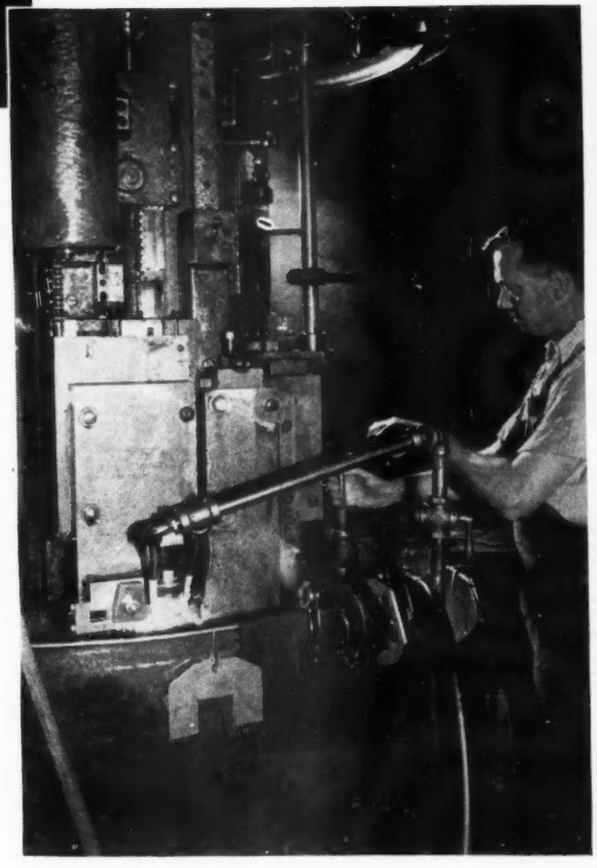
tery of new Hepburn lathes imported from Canada. Semi-finish turning is done in Stamets and Hepburn lathes.

Following the initial machining operations, the shells are ready for the hot nosing. They are heated by immersion in Ajax salt bath furnaces, then nosed in a large Watson-Stillman press. The shells then are loaded onto the monorail conveyor for transportation to the newly built heat treating department. This department, one of the most modern to be found in the industry, has a battery of six Surface Combustion heating furnaces of continuous gas-fired type, each one communicating directly with an adjoining quenching tank built into the floor. Work is dumped directly into the quench tank from the exit end of the furnace so as to avoid the variable temperature changes that occur upon exposure to the atmosphere.

(Above) This Blanchard vertical surface grinder is a recent addition to the Willys machine shop.

(Below) Operator's station on one of the huge Bullard Mult-Au-Matics in the shell nose piece machining department at Willys. Note the assortment of templates and gages for checking work in progress.

Exit end of the long horizontal hydraulic Elmes draw bench which is employed for the formation of the large shell bodies. This draw bench has a series of six draw rings through which the blank is carried progressively to break down the rough blank diameter to the required form and size.



Directly in line with each of the heating furnaces and quench tanks is a Surface Combustion drawing furnace, into which the forgings are moved on a special flight conveyor from the quench. Adjoining the heat treating department is a separate room housing a battery of new Pangborn shot blasting cabinets for cleaning in preparation for the final machining operations.

The shot blasted shell bodies return to the machine shop on the monorail conveyor and are then routed to the finishing operations. For example, they are finish-turned on turret lathes made by Stamets and

(*Turn to page* 76, *please*)

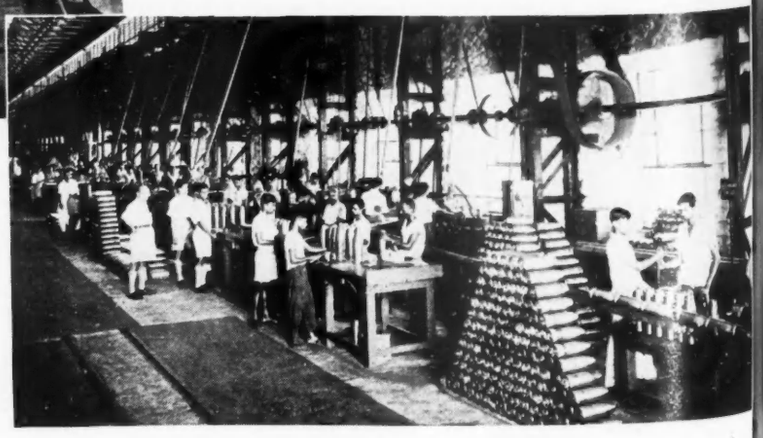
India's

LIKE in many other countries, through the stimulus of war industrial development has moved forward rapidly in India during the past two years with the result that the productive capacity of her prewar industries has increased considerably and in addition many new industries have been established there. Despite her vast natural resources, she lacked the manufacturing capacity to undertake quick expansion and hence was dependent on outside sources. Plant equipment, metals and other materials sent from United States are credited with a big share in making the expansion and modernization of the plants possible. A few warplanes have been built and these and many of her military vehicles are of American design.

At present India is making over 700 items of war materials for the Indian army and for export, including various chemicals, warplanes, military vehicles, naval vessels, electrical equipment, plant machinery, munitions and others. Although large amounts are being manufactured, their flow is not in volume quantities as accepted in this country. In general the engineering technique there still remains on a jobbing basis, but with factory expansion under way on a large basis, and volume production and precision manufacturing methods starting to be adopted, India should have considerable industrial possibilities in the postwar period.

Motorized war equipment being built in India comprises over 50 different types ranging from completed armored vehicles to those with wooden bodies. Before the war, all armored fighting vehicles were imported from Great Britain due to the lack of armor plate manufacturing facilities in India, but in 1940 a satisfactory type was developed at the Tatas steel plant and early in 1941 the first Indian-built armored vehicle was completed.

Amored bodies are built in ordnance



(Above) Railway toolrooms are producing 1000 gages weekly. These Indian gage finishers must work to close tolerances.

(Top of page) An armored car leaving the shop for its trial run.

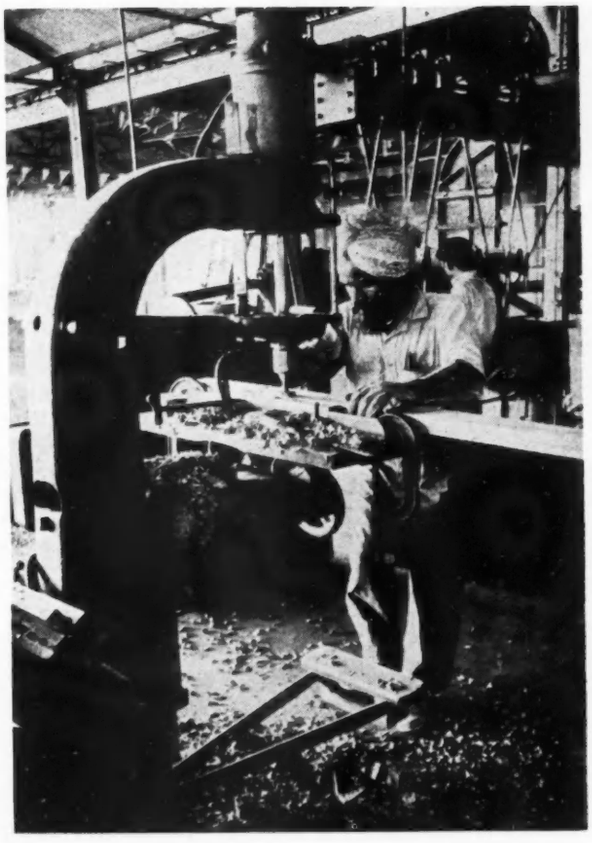
(Right) Final operations on shells are done in this machine shop.

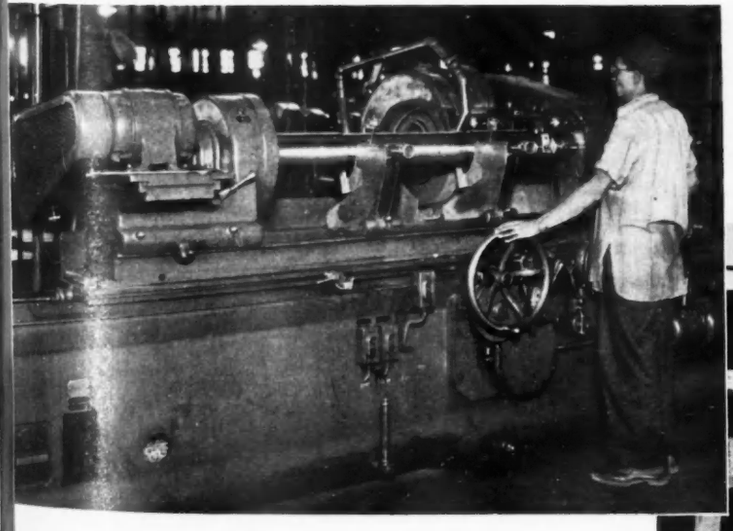
War Shops

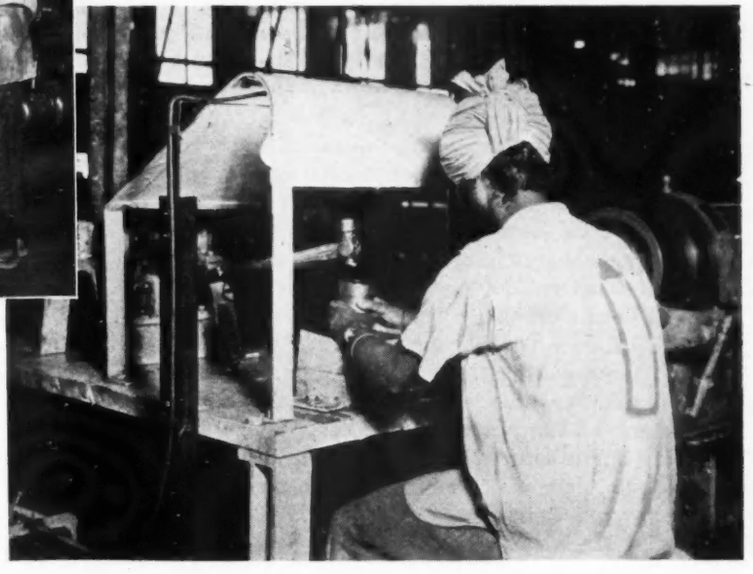
By James R. Custer

factories and railway workshops, chassis for which come from the automobile assembly plants. Special chassis also are imported for tanks and certain types of armored cars. The automobile plants, including General Motors and Ford, also are producing other types of military vehicles, such as trucks, tractors and ambulances. A large number of firms are engaged in body-building, one of which is making several hundred bodies a month according to the latest information from that country. Previous to the war the Indian Army had 5000 vehicles. In service and on the way today are 60,000 units. Likewise, the production of tires has been increased at India's plants and plans have been formulated for an expansion of that industry. India now makes most of the special heavy-duty tires for her army vehicles.

Erection of India's first aircraft plant was started in 1940 and its completion was facilitated by shipments of most of the essential machine tools and plant machinery from United States. In July of last year the first warplane, an American-designed Harlow trainer, was produced at this Hindustan plant. It is a low-wing monoplane equipped with a radial engine, constant speed propeller and retractable undercarriage.







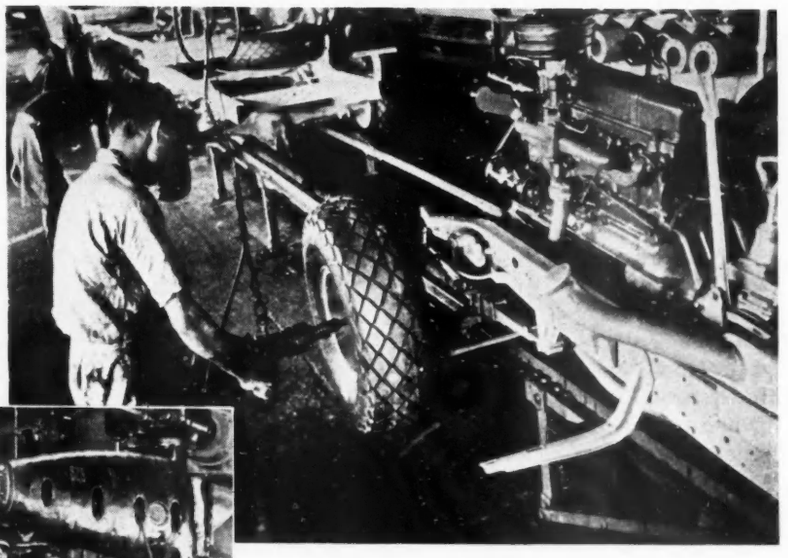
(Above) American-built machine tools are being used in many instances. Here an Indian worker is grinding a field gun carriage axle.

(Top right) Mortising ambulance body parts at the commercial body department of the General Motors plant in India.

(Right) This setup is used for peening the base plates of shells. The hood functions as a reflector with electric lights mounted under it.

(Right) Motor assembly lines are being used to build chassis for military vehicles. This view shows an assembly line at the General Motors of India plant.

(Below) A section of an Indian factory where armored cars are being built.



Since then a few Curtiss Hawk fighters have been produced. Most of the parts and other materials used in these aircraft had to be imported, so it has now been decided to devote this factory to maintenance and repair work, particularly in view of the large number of American and British aircraft in India and on the way.

Research on aircraft timber is being conducted at the Forest Research Institute in India. During World War I Indian timbers were ruled out for aircraft purposes due to the requirement of long spars, but a recent survey showed that 75 per cent of timber used in modern aircraft is made up of 10-ft lengths or less. It has been found that a careful selection of Indian spruce and fir can supply such timber and that they are claimed to be actually stronger than sitka spruce. Promising experiments are going forward in making aircraft propellers of sissoo, walnut and padauk woods. In the plywood field, a special type of synthetic resin glue has been evolved that gives plywood an adhesive strength of over 500 psi and over 300 psi after the plywood has been in boiling water for eight hours.

The Indian machine tool industry is being expanded rapidly and at the present time simple machine tools are being manufactured now in fairly large quantities. All machine tools are under rigid Government control irrespective of their age.

The first Machine Tool Control Order was introduced with effect from March 1, 1941. Under this order a license was required for the import, production, keeping for sale and sale of certain kinds of machine tools (described as "scheduled machine tools") and an authorization was required for the acquisition of any such machine tool. The Machine Tool Controller, who was appointed under this order, was empowered to fix prices for scheduled machine tools, to requisition machine tools, to inspect or arrange for the inspection of any premises in which machine tools were produced, kept for sale, sold, or used, and to call for certain information in respect to machine tools. The scope of the machine tool control order was further extended by an amendment issued in August, 1941. Under this amendment, all machine tools, irrespective of their age, or condition, were brought under the government's Machine Tool Control and had to be licensed.

The Non-Ferrous Metal Control Order, 1941, which came into force on July 21, 1941, provided for the control of nickel, zinc or spelter, and electrolytic copper. The Iron and Steel (Control of Distribution) Order, which came into force on Aug. 1, 1941, applied to the main types of iron and steel produced in India, including pig iron, ingots and billets, tinbar and tinplates, structurals, rails, black sheets and galvanized sheets, plates, bars, bolts, nuts and screws, and wire and wire nails.

The general effect of the order was to prevent the acquisition or disposal of iron or steel by anybody except under the authority of license issued by a Department of the Central Government to which a steel quota had been allotted, or of a written order of the Iron and Steel Controller, who was appointed under the order. The order also gave the Iron and Steel Controller power to require producers and stockists of iron or steel to keep accounts and records relating to their business and to call for such returns and estimates as he might require from them and to have their premises inspected.

Airbriefs

By HENRY LOWE BROWNBACK

Igor Sikorsky

A few days ago while on the Washington-New York train, a familiar figure took the seat ahead of me. The last time I had seen Mr. Sikorsky was at the last Paris Salon in 1938 when the European clouds were very dark. He showed me some of the new work, including his new helicopter, and we had a long talk on the future of aviation. Instead of being satisfied with the wonders he has performed over the past few years, this great scientist is far from satisfied with the airplane as it is now designed and is searching for the formula, being looked for by many of us, for a plane which any man can operate in safety and which will take off of and land in small fields which are surrounded by hazards.

Even though many experts tell us in all good faith that aeronautical science is so well understood in its fundamentals that the airplane as we know it is the final answer, I cannot help but feel that some day someone will find a way of building a plane which is safe in the hands of anyone and which will make the speed which we want with an expenditure of power we can afford to buy. Once upon a time a Los Angeles real estate man told me that the motor car had made the 20-mile suburb possible and that he looked forward to the day when the airplane would make the 150-mile suburb a reality and you know and I know that this cannot be done with the airplanes we know. Let us hope that Mr. Sikorsky or some other equally gifted worker will solve the riddle.

Cargo Ships

The cargo plane argument still rages with glider trains holding a very prominent seat in the background. I was amused recently at one noted commentator who "discovered" that the noted German shipyard of Blom and Voss was building airplanes and used this as an argument in favor of Messrs. Kaiser and Higgins. Hitler had put the shipyards to building airplanes, why shouldn't Roosevelt? He failed utterly to realize that the situation was just a little different. In Europe major shipyards in every ship-producing country have built planes for years. Blom and Voss built them in the last war and ever since. Penhoet in France, builders of the ill-starred *Normandie*, built planes for years, in Italy the Cosulich Malfocone shipyards at Trieste have been a major plane-producing concern and when we turn to England we find that the first non-stop Atlantic crossing was made by a Vickers Vimy bomber made by a shipbuilding concern—Vickers Ltd. This is not written to disparage the aspirations of our shipbuilders in the plane field, but simply to show that, while they must get their plants organized, their planes and engines designed and tooling made and their organizations given plane building experience, the foreign shipyards doing aircraft work are old hands at the game. It is to be hoped that the combination of Messrs. Kaiser and Hughes will do great things, as both of these men have done great things and both have ability and imagination.

Headaches

The average manufacturer who has been used to running the average business and finds himself through force of circumstances in the manufacture of military aircraft or their accessories usually goes through a period of disillusionment, more or less acute reorganization pains and then survives a lot better for his experience or falls by the wayside.

Perhaps no other industry faces the same problems of organization that are an every-day routine to the airplane builder with the minute inspection of materials, the just as minute follow-through and its inspections and the final assembly and building with more inspections and controls using reams of forms all done under high pressure and the necessity of working with plans made under pressure with inexperienced men, often full of errors and subject to constant changes forced by enemy competition. Add to this the difficulties experienced with procurement and you have a combination which is ideal for the makers of aspirin.

One could write a long article which might help the unwary over many of the pitfalls and the subject is too drawn out to be touched here. Therefore I will give but one bit of advice. Before trying to break into the manufacture of aircraft or accessories get a core staff of experienced, old timers if possible, men and then set up a fully organized inspection, engineering, plant protection, production planning and accounting system before you turn a wheel and school the whole staff minutely in the maze of regulations and specifications and insist that these be followed to the letter.

For instance a wood working contractor gets spruce beams inspected, marked and numbered and then makes them into spars without carrying the number identifying them along only to find the whole program in a jam as he cannot identify the wood used as inspected material. This is but an instance. Every precaution must be taken to do first class work, but doing it in the prescribed manner and according to prescribed routine is just as necessary. Know what you are going to do, find out how it should be done—not by your experience but by ANN regulations and requirements and then be far more careful than you ever were before and consider yourself not as a manufacturer beholden only to yourself, but as a unit of the military establishment, really just part of the Government and subject to all of its rules and regulations, and red tape if you will, and carry on without any thought of hours and you will have 90 per cent of the battle won.

Those Zeros

Probably the airplane about which the least public information has been released is the Jap Zero fighter. This has made it into an almost mythical monster. Actually it seems to be going through the same general life history as most other airplanes. The Zero in the beginning was very fast and maneuverable in spite of the big radial engine in its nose and raised havoc with the Allied fighters as it could outmaneuver them tremendously. It was noticed, however, that once a bead was drawn on one and it got a dose of incendiary bullets it burned like a torch. Later models resisted gunfire better but were less maneuverable and climbed slower—the same case as adding armor protection, fuel tank protection and armament, thus increasing weight and wing loadings and decreasing handling qualities. You pay your penny and you take your choice, but to date no one has discovered the secret of having your penny and your cake both at the same time.

Jet

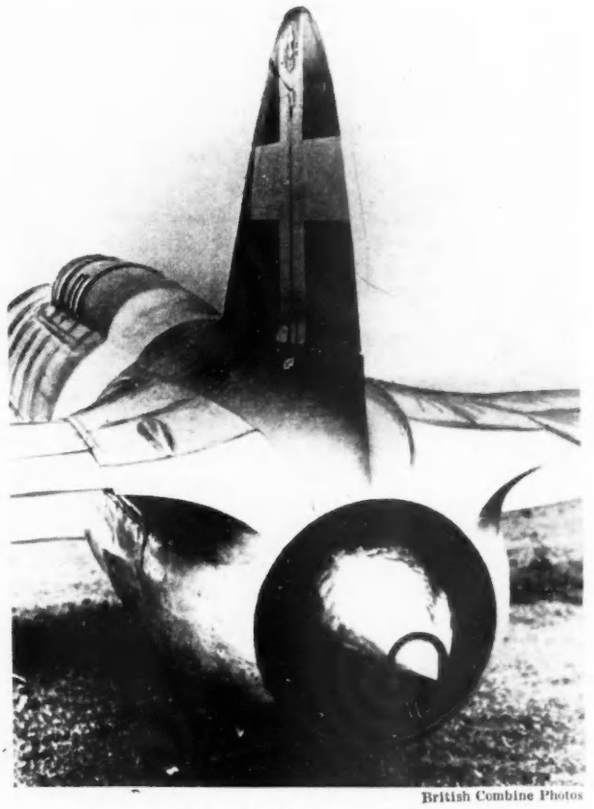
REPORTS from Italy last winter that an airplane equipped with the Campini system of jet propulsion had been flown from Milan to Rome by the one-time Schneider Cup holder de Bernardi served to revive interest in this system of propulsion, which has long been an outstanding problem of aircraft engineering. The first test flight, of about 10 min duration, was made in August, 1940, but the Milan-Rome flight seems to have been the first sustained flight ever made in an airplane using jet propulsion.

A jet-propulsion plane is akin to a rocket, in that the propulsive effect is obtained from the reaction to rearwardly-discharged products of combustion. There is a certain relation also between the propulsive effect in a jet-propelled airplane and the recoil of a gun, though in the latter the reactive effect comes from the projectile which is being accelerated, while in the former it can come only from the atmosphere.

In the conventional airplane engine, power is generated by heating air and allowing it to expand in a cylinder, whereby the thermal energy of the gases of combustion is in part converted into mechanical energy. If instead of letting the gases under pressure act against a movable piston, we let them act directly against the atmosphere back of the plane, we get a propulsive effect in a much simpler way. To get a propulsive effect in this way is no problem at all. The problem of practical jet propulsion consists in obtaining an efficiency of conversion of heat energy into energy of propulsion which is at least approximately equal to that obtained with the conventional engine-propeller system.

It is worth noting in this connection that the efficiency of a modern air propeller is comparatively high, of the order of 80 or 85 per cent. Power losses in a propeller system are due to the fact that, in addition to producing air flow in the direction opposite to that of flight—which alone can give a useful propulsive effect—the propeller imparts to the air also a circular motion around its axis and a slight radial motion. Another cause of loss is the turbulent motion of the air which results from the passage of the inactive hub portion of the propeller through the atmosphere. The brake thermal efficiency of the aircraft engine will be about 30 per cent, and if this is combined with a propeller efficiency of 83 per cent we arrive at an overall efficiency of 25 per cent, which must be equaled by the jet-propulsion system.

In order that a satisfactory efficiency may be obtained with jet propulsion, the heat energy of the gas must be largely converted into kinetic energy before the gas is discharged from the propulsive unit. Discharging a gas at a certain velocity from an orifice of given size gives the same propulsive thrust regardless of the temperature of the gas, and since the energy content of a unit volume of the gas is greater the higher its temperature, the efficiency is lower when the gas is discharged at a high temperature. Further, the atmosphere is not very dense, and to get an adequate thrust, the discharge jet must have an appreciable cross section. One cannot get much of a reaction by thrusting a pencil pointforward into the atmosphere, but one can get such a reaction by whipping a fan through the atmosphere, even at a moderate speed. These requirements can be met by mixing the products of combustion with a multiple of their mass of atmospheric air. This mixing of the burnt gases with air reduces the velocity of discharge of the gas, but the increase in the mass discharged and in the area of discharge more than makes up for the loss in velocity, and the propulsive efficiency is raised.



British Combine Photos

The rear duct of the Caproni-Campini jet propulsion plane

To further raise the efficiency of conversion of heat energy into mechanical energy of propulsion it is necessary to burn the fuel in compressed air, rather than in air at the pressure of the surrounding atmosphere. In entering the propulsive unit in flight, the air is slightly compressed by the ramming effect, but this is not sufficient, and in most of the systems proposed it is further compressed by means of a centrifugal blower. Such a blower, of course, requires power to drive it, and this power can be derived either from a

Propulsion Developments

By P. M. Heldt

conventional internal combustion engine or from a gas turbine through which either some or all of the products of combustion are passed. Only a part of the energy of the gases of combustion is given up in the turbine, most of it being retained in the form of kinetic energy.

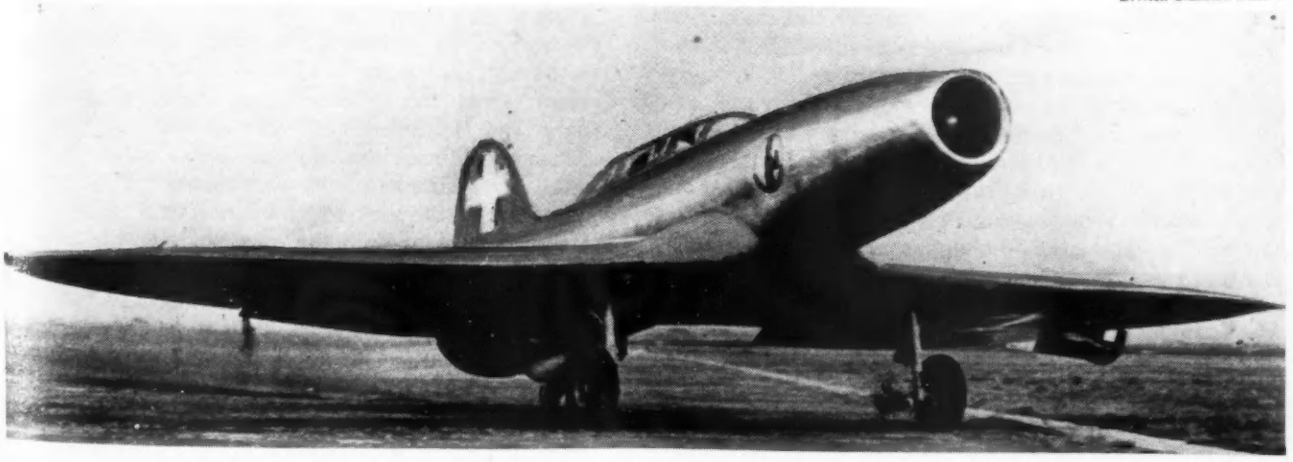
References to the jet-propulsion system first began to appear in patent and scientific literature in 1908. In that and the following year, patents were granted to two Frenchmen, Marconnet and Lorin, which covered some of the basic elements of the system. In their patent drawings both showed compressors for forcing atmospheric air or combustible mixture into a combustion chamber, where the fuel or combustible mixture was ignited and from which the products of combustion were allowed to discharge rearwardly through a trumpet. Marconnet described various alternate arrangements. In one, atmospheric air compressed in a Roots blower was forced through a carburetor into the combustion chamber, while in another a centrifugal blower forced air through the carburetor into a device not unlike a mechanical siren in form, having a rotor which alternately opened and closed ports in the cylindrical housing. From the ports in the housing, passages led to a throat in which the ignition device was located. The idea, of course, was that as ignition occurred and the pressure in the combustion chamber rose, the latter would be cut off from the blower by the siren rotor acting as a rotary valve. But the inventor must have anticipated some difficulty in getting the flame propagation and the rotor motion to synchronize, for in another drawing he shows a check valve at the entrance to the combustion chamber, which would close automatically as the pressure in the chamber rose above that at the outlet from the blower. Lorin in one of his patents showed a multi-cylinder horizontal engine with a large rocking valve in the head. Induction, compression and ignition were to take place as in a conventional engine, but at the moment of ignition the rocking valve was opened mechanically and the cylinder contents were allowed to escape rearwardly through a trumpet secured to the cylinder head. There were six such trumpets side by side.

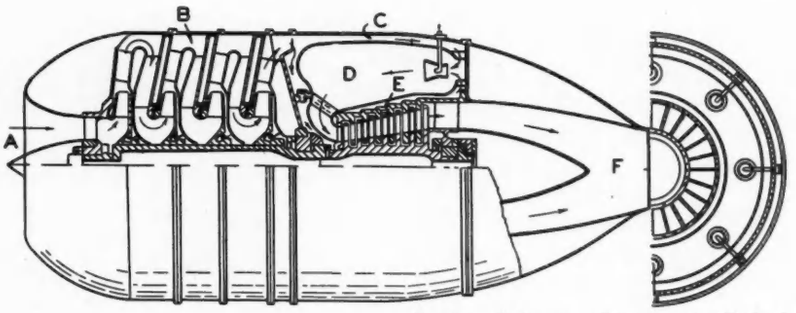
The idea of mixing atmospheric air with the products of combustion was first disclosed in a patent issued to an American inventor, Lake, in 1909. He showed a trumpet of rectangular cross section, in which fuel for combustion purposes entered at the small end, to which additional air was admitted through oblique slots or ports in the sides. This tube discharged into another, larger one, also provided with air ports, which was referred to as a diffuser. Both of these tubes were surrounded by a third tube designed to guide the air and to prevent excessive loss of heat. The additional air was drawn in by an injector effect. Since that time most of the jet propulsion systems described in the patent literature have provided for mixing the products of combustion with additional air.

Since the first actual flight with jet propulsion seems to have been made in a machine built by the Caproni Works, it is interesting to note that G. Caproni in 1934 took out patents covering a system in which the discharge of the exhaust gases is made to assist the propeller. Two arrangements were illustrated. In one, a large venturi tube extended lengthwise through the fuselage. The exhaust collector of the engine discharged into this tube near its throat and the radi-

The Caproni-Campini CC-2 jet propulsion airplane that flew from Milan to Rome, a distance of about 168 miles. For this first flight the average speed was 130 mph. It weighs 11,000 lb., has two seats in tandem and is equipped with a retractable undercarriage

British Combine Photos





Courtesy of AIRCRAFT ENGINEERING (England)

Fig. 1—The Lysholm jet-propulsion unit shown partly in section

ators for the liquid-cooled aircraft engine were located in the forward section of the tube, the forward end of which completely surrounded the engine, so that most of the waste heat from the engine went into the jet. In the other arrangement the forward section of the venturi was substantially the same, but the rear section was bifurcated and the gases were discharged rearwardly at opposite sides of the fuselage.

Patents on jet propulsion have been issued also in the name of A. Lysholm, chief engineer of the Ljungstrom Steam Turbine Co. of Stockholm, Sweden, who is best known in the automobile industry as co-inventor of the Lysholm-Smith hydraulic transmission for buses and railcars. His patents on jet propulsion were assigned to Milo Aktiebolaget of Stockholm. A sectional view of one of the propulsive units is shown in Fig. 1. Air at atmospheric pressure enters the unit at A and is compressed in the multi-stage centrifugal compressor B, whence it passes through an annular passage C close to the wall of the unit and enters the combustion chamber D at the rear. At the entrance to the combustion chamber there are a number of venturi tubes with fuel nozzles centrally within them. At the outlet from the combustion chamber the products of combustion are mixed with additional air from the blower and the mixture of gases passes through an axial turbine E where part of its energy is utilized to drive the compressor and may be used also to drive a propeller, which latter would be located in front of the propulsive unit. The exhaust from the turbine, deprived of only a fraction of its initial energy, enters an outlet channel F, whose effective cross section diminishes toward the outlet.

In an alternate design there are two two-stage centrifugal compressors arranged in tandem. After the air has been compressed in the forward or low-pressure compressor, it passes around a radial gas turbine, absorbing heat, and then enters the second compressor. From the latter it passes through an annular channel inside the shell of the propulsive unit to the rear of same, where it enters the combustion chamber. Some of the air enters the combustion chamber through a venturi tube, at the entrance to which there is a fuel nozzle, while the remainder enters the chamber through an annular passage surrounding the venturi. From the combustion chamber the gaseous mixture is carried to the radial turbine, and from the latter it passes radially to rearwardly-directed outlets at the top and bottom of the propulsive unit. All of the essential elements are the same in both designs, the chief differences being that in the first the propulsive jet is arranged centrally at the rear of the unit while in the second there are two jets, at the top and bottom of the unit near its maximum diameter. The first has an axial, the second a radial gas turbine, and the gas turbine in the second arrangement is cooled by air that has passed through the first stage of the compressor, while in the first design the turbine is located inside the combustion chamber and is cooled only by air that has passed through four stages of compression and is therefore at a relatively high temperature.

A U. S. patent was issued not long ago to Max Hahn of Rostock, Germany, assignor to Ernst Heinkel, for an aircraft powerplant adapted for jet propulsion. There are no new features in this propulsion unit (Fig. 2) but the arrangement of the various elements is somewhat different than in other designs and the elements are of the simplest possible form, a single-stage centrifugal compressor A and a single-stage turbine B being shown. There is a channel C in the housing of the propulsive unit for admitting air, and another channel D for the discharge of gas. Two bearings, E, E, are provided in the propulsive unit, both supported by the housing of the latter, one being located in the inlet and the other in the discharge channel. Journaled in these bearings is a rotor which comprises the impeller of the compressor and the runner of the turbine. The entrance to the compressor is adjacent to the entrance channel of the housing, and the discharge from the turbine adjacent to the discharge channel of the housing. The vanes of both impeller and runner comprise an axial and a radial section. There is an annular combustion chamber F in the forward part of the unit which connects the outlet ports of the compressor with the inlet ports of the turbine.

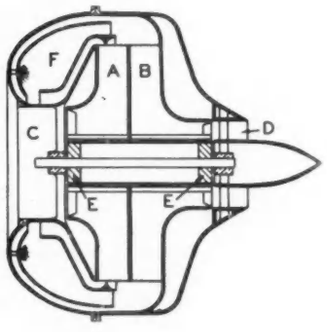
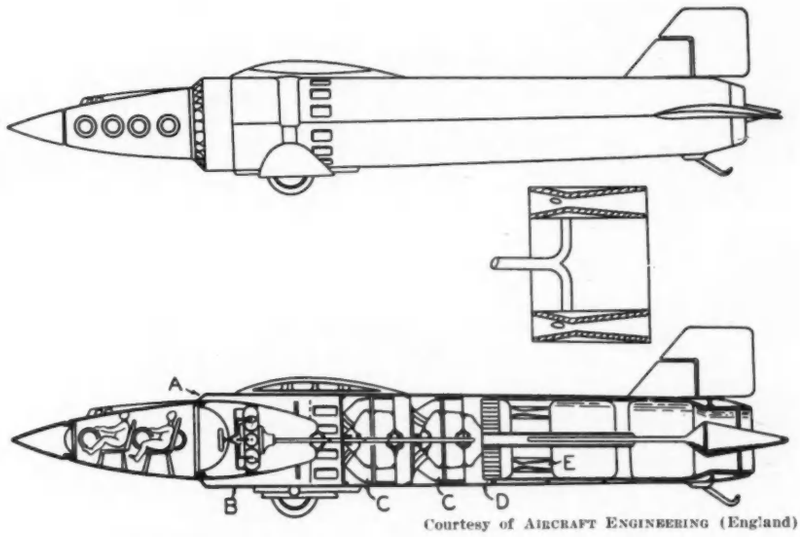


Fig. 2 — The Hahn (Heinkel) jet - propulsion unit

Courtesy of AIRCRAFT ENGINEERING (England)

The Campini system of jet propulsion has been explained by the inventor, Secondo Campini, in very general terms in a number of papers published in the Italian aviation periodicals *L'Aeronautica* and *L'Aerotecnica*, and also in patents issued to him in various countries. Referring to Fig. 3, which is redrawn from one of the patent drawings, air enters the propulsive

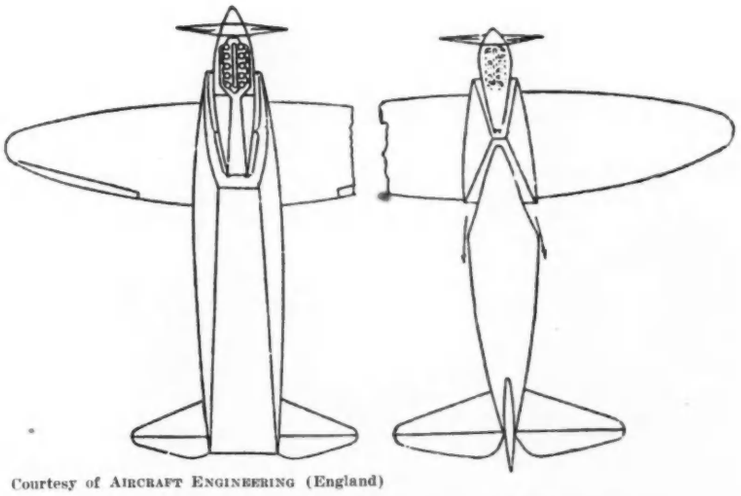
unit through an annular opening A surrounding the cabin, as a result of the motion of the plane through the atmosphere. Upon entering the intake duct the air is subjected to dynamic compression, because its motion relative to the ship at the entrance is destroyed a short distance farther back. One of the features covered by this patent is means for adapting the ship to travel at both subsonic and supersonic speeds (speeds below and above the velocity of sound, respectively). In order to effect dynamic compression at subsonic speeds it is necessary that the inlet duct increase in section from the inlet back, while for the same effect at supersonic speeds it must decrease in section from the inlet back. Campini effects this adjustment in a simple manner by giving his unit an ovoid section and surrounding it with a cylindrical shell B which can be moved axially. For flight at subsonic speeds the shell is so adjusted that its forward end is in the plane of the largest section of the unit, while for flight at supersonic speeds it is moved forward, so that the inlet duct first converges and then diverges. By comparing the patent drawing with the photo of the actual plane, it can be seen that this feature is not made use of in the latter. The patent drawing also shows an "altitude chamber" at the extreme forward end of the unit, which is releasable and can be allowed to float to earth by means of a parachute. This feature also is not embodied in the actual plane, which evidently was designed for use at moderate altitudes only. Aside from these differences and the fact that the patent drawing shows a high-wing construction while the actual plane is of the low-wing type, there is considerable similarity in the general forms of the two units.



Courtesy of AIRCRAFT ENGINEERING (England)

Fig. 3—Patent drawings of the Campini propulsion system

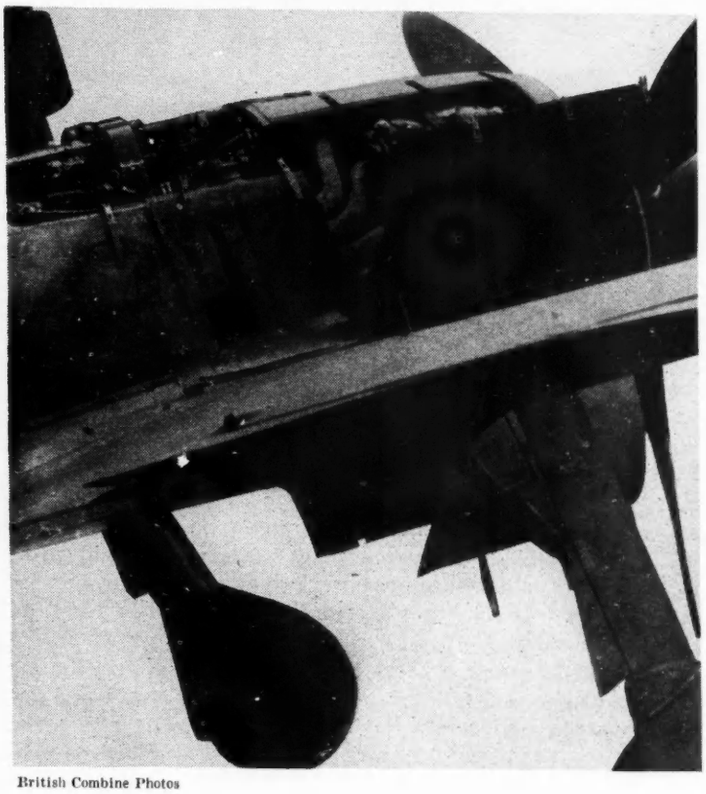
In normal flight the air enters the unit at the front. There it has a certain velocity relative to the plane, and by virtue of this velocity it possesses kinetic energy. When it is deprived of this relative velocity at the end of the inlet duct, this energy is largely converted into pressure energy. At the takeoff, when there is no motion relative to the atmosphere, air is taken in through adjustable ports in the shell of the unit near the end of the inlet duct. In normal flight, the air which has been compressed dynamically in the inlet duct, enters a centrifugal compressor C driven either by a combustion engine or a gas turbine, in which it is compressed further. In the drawing two centrifugal compressors are shown, arranged in tandem. Back of these compressors there is a radiator D for the cooling water of the combustion engine, and this radiator serves also to straighten the air currents, that is, to produce streamline flow. Back of the radiator the cross section of the unit is divided into three concentric channels, a central and an outer duct, and an intermediate channel E of venturi form. A series of fuel nozzles is arranged in the wall of the venturi immediately ahead of its throat. Fuel is sprayed into the throat, where it mixes with the air, and after being once ignited, the jets burn continuously. Combustion takes place at constant pressure, the pressure produced by the compressor, but the volume of the air is increased several-fold by the combustion of the fuel in it. At the exit from the venturi-like passage the gases of combustion mix with the air flowing through the central and outer ducts and increase its velocity. Attention may be called to the fact that practically all of the heat of combustion produced in both the engine and the combustion chamber is contained in the gaseous jet discharged at the rear of the unit. The mass discharged at the rear is practically the same as that entering the unit in front (within 1 per cent, the proportion of fuel mass to air mass), but much energy has been added by the heat of combustion and it issues at a much higher speed than at which it enters.



Courtesy of AIRCRAFT ENGINEERING (England)

In these Campini designs the engine exhaust is used for additional propulsion

The Focke Wulf FW 190



British Combine Photos

This closeup reveals some of the the details of the engine installation. On top of the engine can be seen barrels of the two 7.92-mm machine guns.

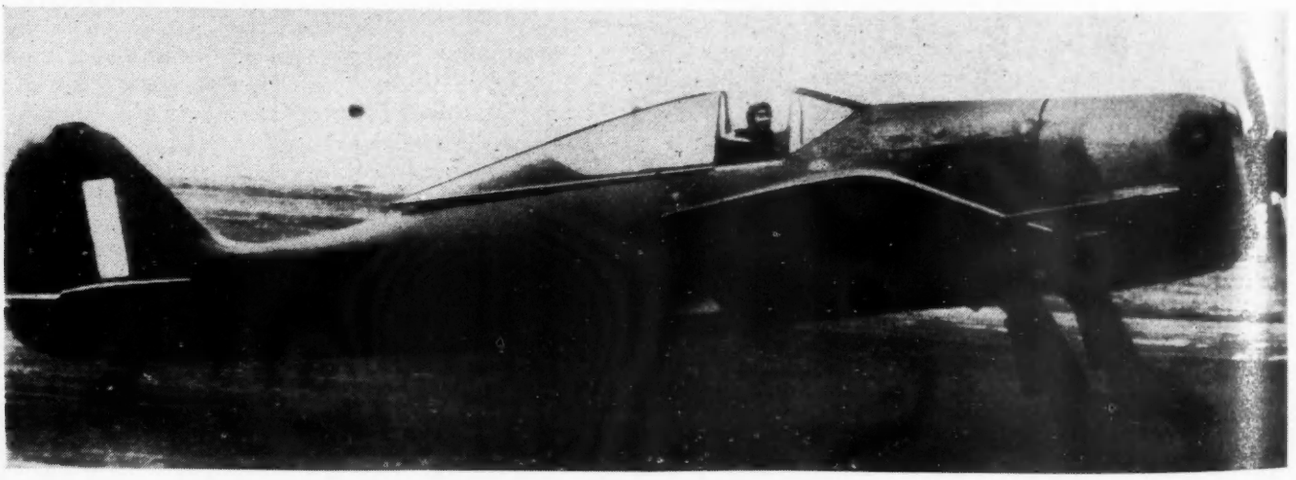
ALTHOUGH on many occasions during the past few months the Royal Air Force has met in combat the Focke Wulf FW 190, Germany's latest type of fighter aircraft, it was only at a comparatively recent date that one of these machines was brought down on the south coast of England in an almost undamaged state. This particular machine, therefore has enabled a close examination to be made of every detail in its normal condition. In addition, the machine has been flown by English pilots and records made of its performance and general characteristics in flight.

Authoritative opinion in England agrees that the FW 190 is the best fighter the Germans have yet produced, a "first-class" machine. But though it is admitted to be a formidable fighter, it is not to be considered as a "war winner." It is not a high-altitude fighter. Its best altitude is around 20,000 ft. Above and below that altitude its capabilities are said to fall off very noticeably, while above 24,000 ft. it is held to be not so good as the Messerschmidt 109, which it was to supersede.

It is a low-wing monoplane with a BMW 801-D 14-cylinder radial engine developing about 1600 hp. for take-off. (This engine was described and illustrated in the July 15 and August 1 issues of AUTO-

The Focke Wulf is powered by a BMW 801 14-cylinder radial engine with a cooling system of revolutionary design. The Dornier 217E bomber is equipped with two power plants of the same design.

Press Assoc. Photo



Germany's Latest Fighter

By
M. W. Bourdon

Special Correspondent of AUTOMOTIVE *and* AVIATION INDUSTRIES in Great Britain.

This view of the Focke Wulf fighter in flight shows its wide wing span and finely tapered fuselage.

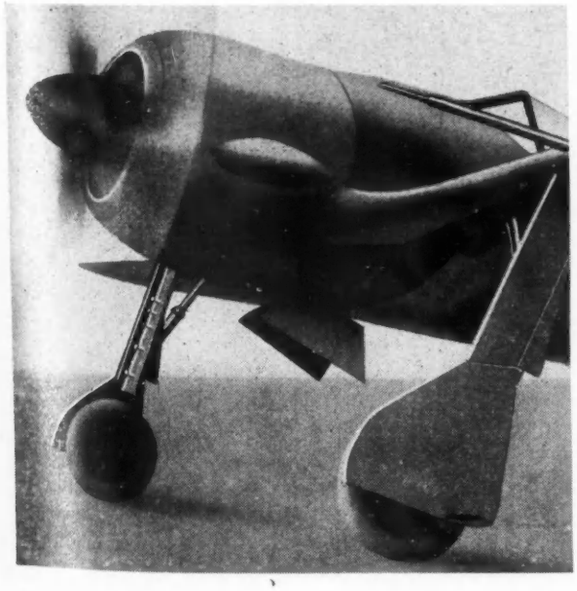
British Combine Photos

MOTIVE and AVIATION INDUSTRIES.) On a data card found in the cockpit it is stated that the speed at 4500 ft. is 326 mph with supercharger gear "M" in use, and 375 mph at 18,000 ft with supercharger "S" gear. The rates of climb are given as 3050 fpm at 4000 ft with supercharger "M" gear and 3280 fpm at 17,500 ft with the "S" gear in use. In an emergency an over-riding boost is believed to give about 390 mph at 20,000 ft.

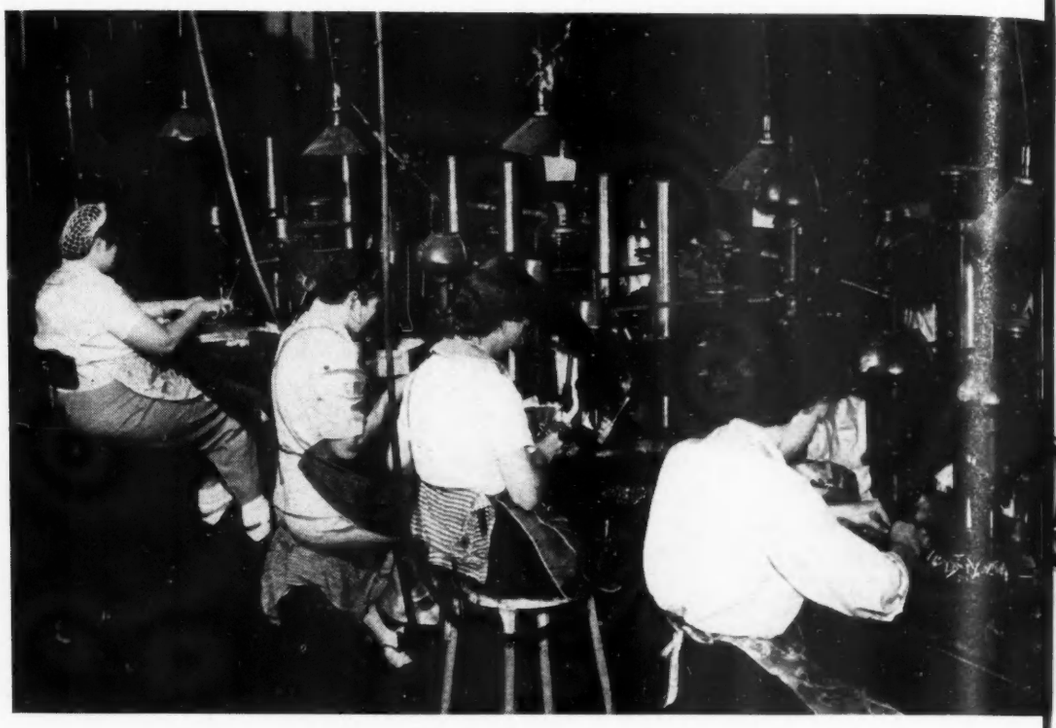
Armament consists of four 20-mm cannon and two 7.92-mm machine guns. Four of these fire through the propeller and two cannon from the wing root.

The wing span is 34 ft 5 in. and the overall length 29 ft 4 in. and with a gross weight of 8500 lb. fully equipped, the wing loading is as high as 42.3 psf. Among other things this implies a high landing speed, for the machine comes in at 125 mph and touches down at 110 mph.

Electric operation is used extensively, including fire control and actuation of the flaps. As regards finish, that of the engine installation and the cowling is good, even first-class, but otherwise the finish is poor, certainly not up to British and American standards. The cockpit is cramped. Although the roof is low, the pilot's view is described as excellent. Only 115 gal, of fuel are carried.

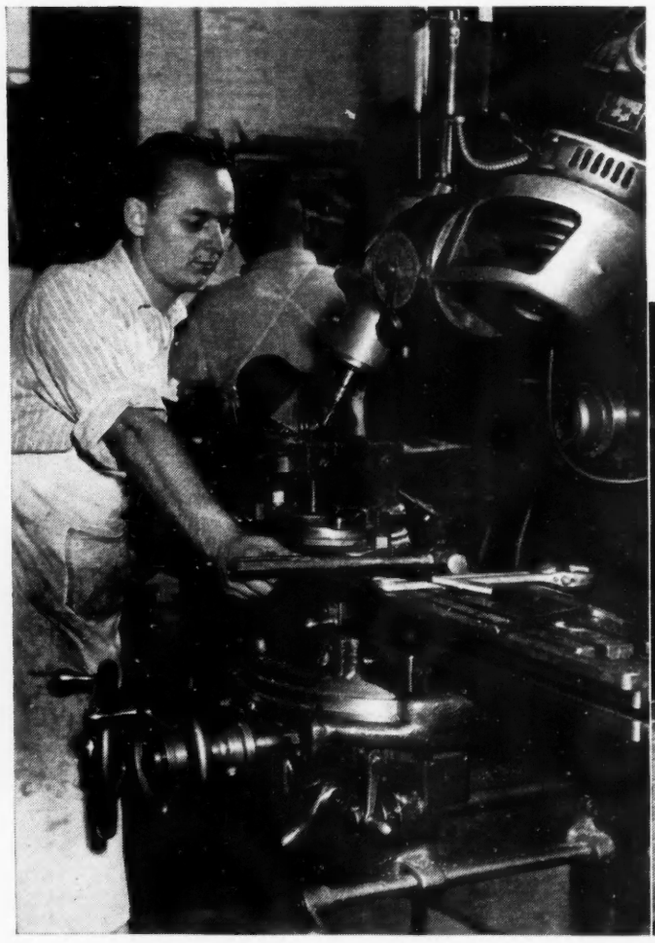


Clean design marks the Focke Wulf nose. Note the wing recesses for the wide undercarriage. (Drawn from material by courtesy of Flight, England).



Another high speed drilling table is this one for handling small parts, made up of nine Buffalo drills.

Another example of the conversion of old equipment is this one showing the application of a Dalrae head which makes an extremely flexible machine out of an old type miller.



Pierce Governor Co.

Surmounts

Production

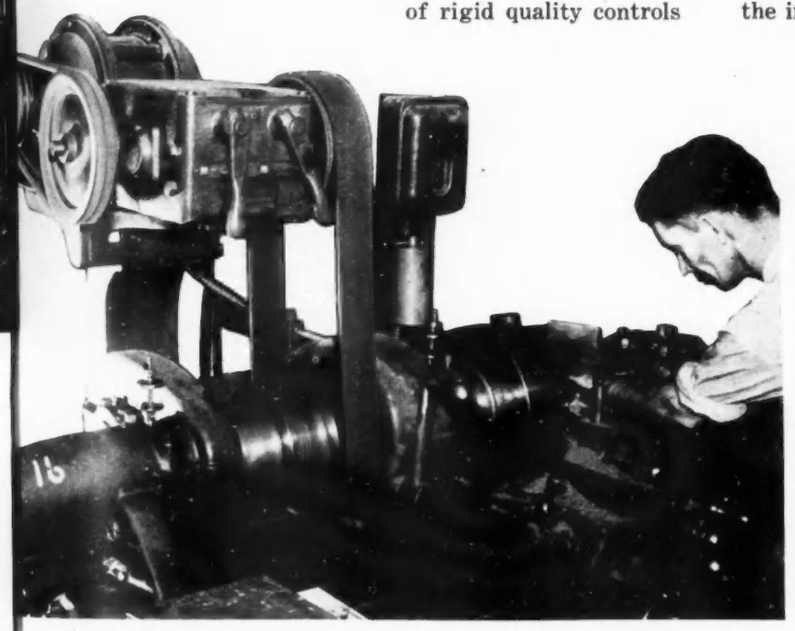
Problems Due to War

By Joseph Geschelin

ALTHOUGH the role of the larger producers in the automotive industry is generally well-known, there is a splendid human interest story in the skill and energy shown by the smaller manufacturers in their efforts to contribute to the war effort. An outstanding example is found in the case of The Pierce Governor Co., Anderson, Ind., an old-line producer of engine governors.

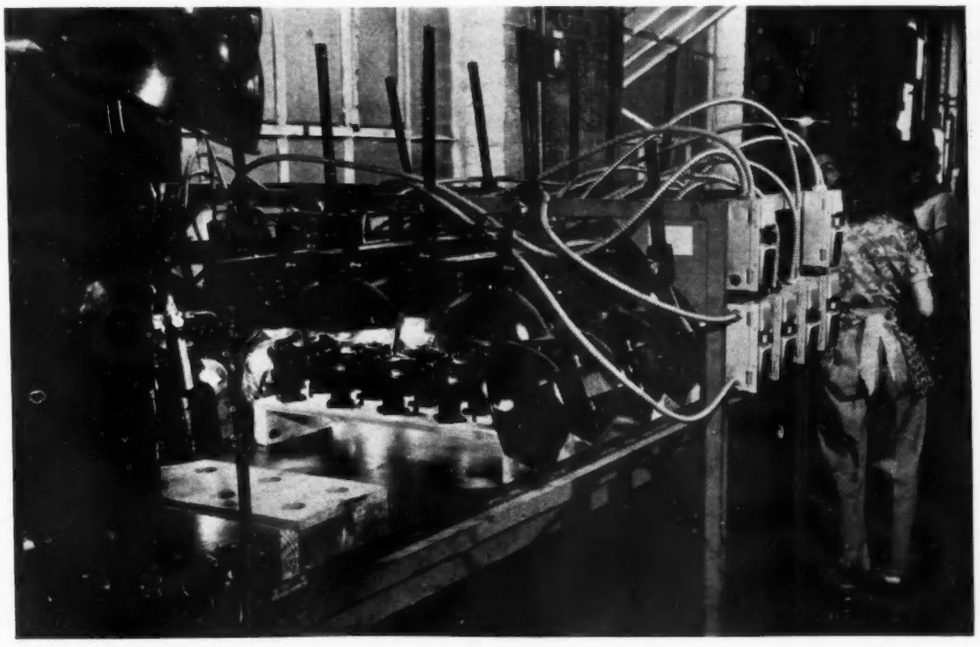
Faced with the knotty problems of competitive selling, the requirement of rigid quality controls unknown in peacetime experience, and the ability to obtain only a small amount of new equipment, this organization has done nobly by the application of toil and native ingenuity. Today this company is said to be producing fly-ball type governors to more exacting specifications than had been conceived as possible heretofore, at a greater rate than ever before. This has been accomplished by better utilization of existing equipment, by improved management methods, and by the installation of additional machinery. Moreover, all of the newly acquired machinery as well as the equipment on hand has been individually motorized to improve performance.

Not the least of the problems confronting Pierce is the matter of a wide range of models and designs—at least 50 distinct "types" with over 2000 customer variations being involved at the moment—making it necessary to have an extremely flexible fabricating set-up, capable of job-lot production. In fact, the largest volume job in the place is a tank engine governor. The

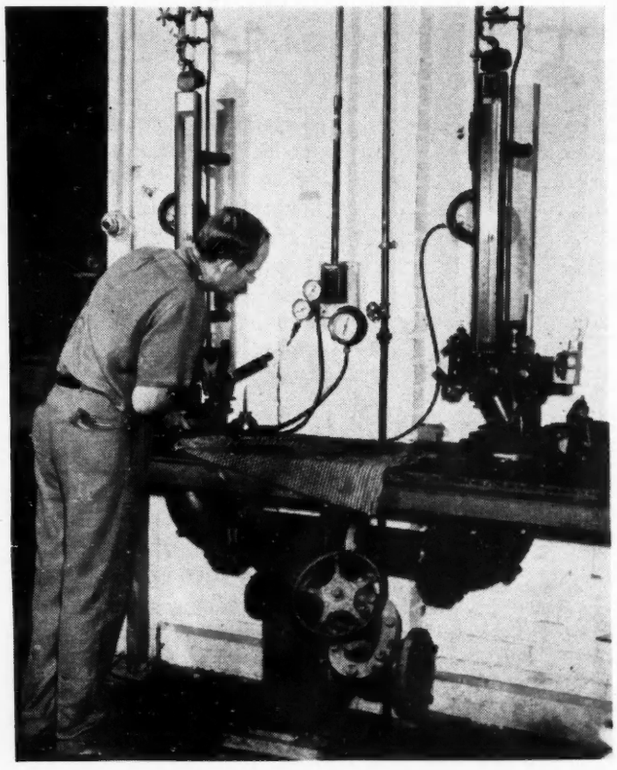


An interesting example of how Pierce has managed the rehabilitation of its old equipment is this application of the Turner Machine Co. Turner Uni-Drive individual motor drive conversion installed on old screw machines and turret lathes.

(Left) Corner in the plating department showing new Parkerizing bath set-up. This department has facilities for electroplating cadmium, nickel, and chromium.



(Right) Distinct touch of modernity is found in this Fostoria Dri-ray Parasphere infra-red lamp baking installation. Containing a bank of 36 lamps, it is expected to reduce drying time from one hour to about ten minutes



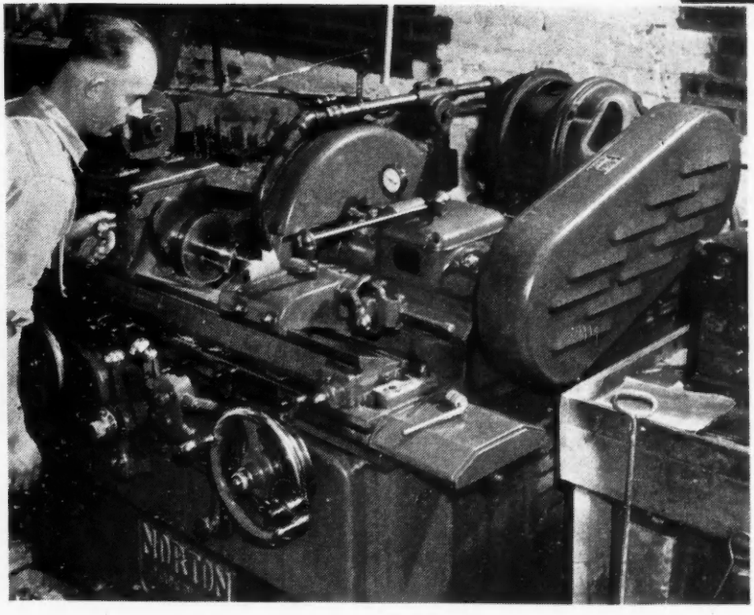
solution of the problem is found in the development of quickly interchangeable tools and fixtures, used almost exclusively on general purpose machines.

Quality control has had to be tightened up due to the exacting requirements of present day military engines. For example, in conventional practice the thrust sleeve on a standard tractor governor has been turned on a screw machine and the shaft hole drilled and reamed. On a military installation of the same character, the work is turned, then ground to 0.0003 in.; and the hole is drilled, reamed, lapped, and polished. Yoke arms are used in the rough-forged state on commercial installations; on a military unit, the bearing must be ground to an accurate radius. Another example—on a tank engine governor, the shaft has six different steps which must be held to 0.0003 in. concentricity axially. Shaft ends are milled to length, then chamfered to a 45-deg. angle by precision grinding with an angular wheel head.

(Above) In the process of installation is this flow bench, designed primarily for the precision testing of a new line of decelerating controls. The apparatus is served by 12 x 12 Roots-Connersville vacuum pump powered with a 125 hp. Westinghouse motor.

(Right) Jones & Lamson two-spindle chucking machine—with air chucks—used for turning and boring operations has had its productivity greatly increased by the use of cemented-carbide-tipped tools.

(Below) One of two Norton cylindrical grinders installed in Pierce plant, this one fitted with an oscillating head for grinding square shoulders on governor shafts. Will hold diameters to 0.0003 in.



These special requirements have been met by the introduction of new or used grinders, by rebuilding or renovating of the old equipment, by the use of massive, precision fixtures. And by the application of the "know-how" of skilled factory management.

These gains, so painfully achieved under trying conditions, have made it possible to produce in volume the finest fly-ball governors known to the art, at relatively low cost, particularly where it is feasible to introduce mass production procedures. Pierce is now making small, compact governors that can regulate automotive type engines from a range of five per cent variation down to as low as half cycle or three-tenths cycle variation on critical electrical equipment driven by internal combustion

Applications of Pierce Governors

Marine—Main propulsion Diesel engines.
For small tenders, etc.
Combat vehicles—trucks, half-tracs, tanks, etc.
Generator sets for—

1. Lighting
   Search lights (automatic aircraft spotters)
   Light plant systems for cantonments, etc.
   Stationary Portable
2. Listening devices (aircraft sound detector)
3. Welding
   Portable machine shops for servicing aircraft and combat vehicles. (These are built on truck or trailer and include besides welder, lathe, drill press, etc., all of which is operated with power unit controlled by governor.)
4. Radio
   Stationary units for CAA
   Readio beam for aircraft direction
   Portable field radio
5. Aircraft
   Auxiliary power units on large bombers used to operate landing gear, lights, etc.

Contractors' equipment being used in construction of airports, army camps, factories, shipyards, etc.

Shovels and earth moving equipment	Cranes
Air compressors	Tractors
Welders	Trucks

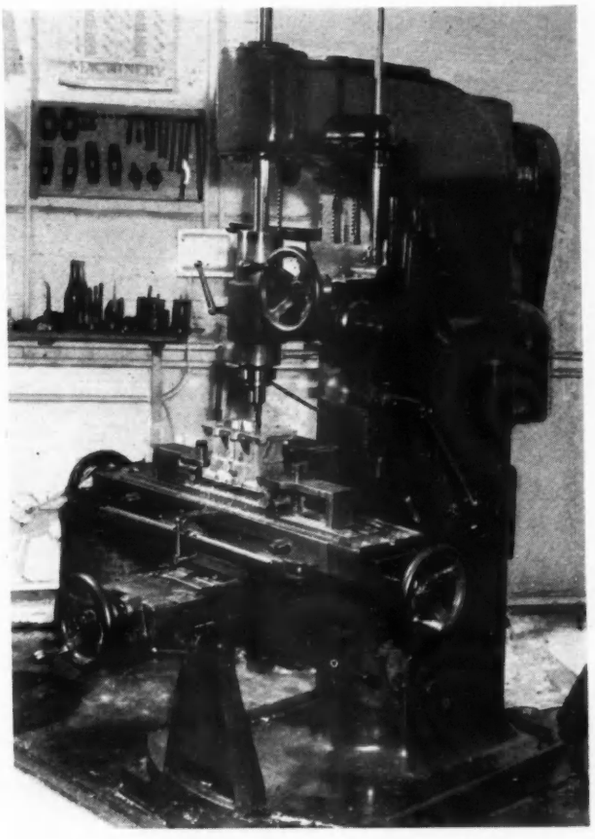
Equipment used directly in the building of ships

Welders	Cranes
Air compressors	

engines. After the war, production governors of new design, stemming from the current experience in design and methods will be capable of far better regulation at much lower cost levels.

So far as the mechanical equipment is concerned, we have selected some items for the pictorial section which will give our readers an excellent visualization of the

(*Turn to page* 80, *please*)



One of two Knight jig borers in this plant, this one being used for small production runs on precision parts such as this large valve box.

(Lower right) View of the furnaces in the new heat treating department, featuring the Houghton Perliton liquid bath hardening process.

(Below) Eight of the versatile Delta drills, set up on this table, produce a high speed drilling line which has given great satisfaction.

Magnesium production specimens welded by the Heliarc method.

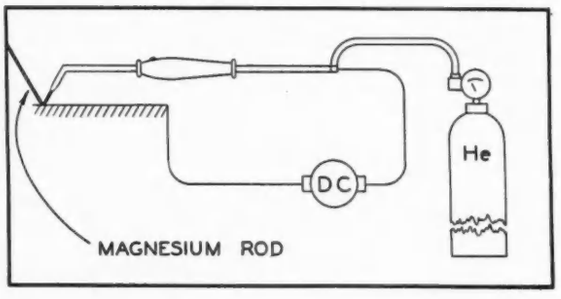
drag, so that a substatial fraction of the engine power is required to overcome this extra drag. It is claimed that the welded magnesium plane can be finished as smoothly as a passenger automobile, and that its drag therefore will be a minimum. While magnesium has been used in the past for certain engine parts, wheels and accessories, it never has been used in the structural parts of the plane, because of difficulties of fabrication. The following description of the new process and account of results obtained with it are based on information furnished by the sponsors.

Magnesium castings with foundry defects have been repaired by the new method, and welds have been obtained which proved equal to, or stronger than, the surrounding metal. The weld metal is far more dense than the base metal, and less susceptible to corrosion. Sections of almost any thickness that can be poured can be welded by the new process.

Welding rod of the same material as the parent metal is usually used for castings and wrought alloys. In salt-spray tests, the weld ingot appears to have better corrosion-resistant properties than the parent metal. The weld head appears to be cathodic to the adjoining metal, and under severe corrosive conditions minor pitting of the base metal occurs adjacent to the weld.

Heliarc

A NEW method of arc-welding, applicable to magnesium sheets, extruded sections and tubing, has been developed and made available to the war industries by Northrop Aircraft, Inc. It is known as Heliarc welding and is claimed to make possible simpler, lighter and stiffer structures than those conventionally obtained with duralumin. The name "Heliarc" is based on the fact that during the welding process the molten metal is surrounded by a shield of helium, an inert gas which excludes oxygen and prevents oxidation or corrosion, thus making the use of a flux unnecessary. The men responsible for the new process are V. H. Pavlecke, chief of research, and Russ Meredith, welding engineer. A method of treating magnesium to make it more heat-resistant and less inflammable was developed at the same time.



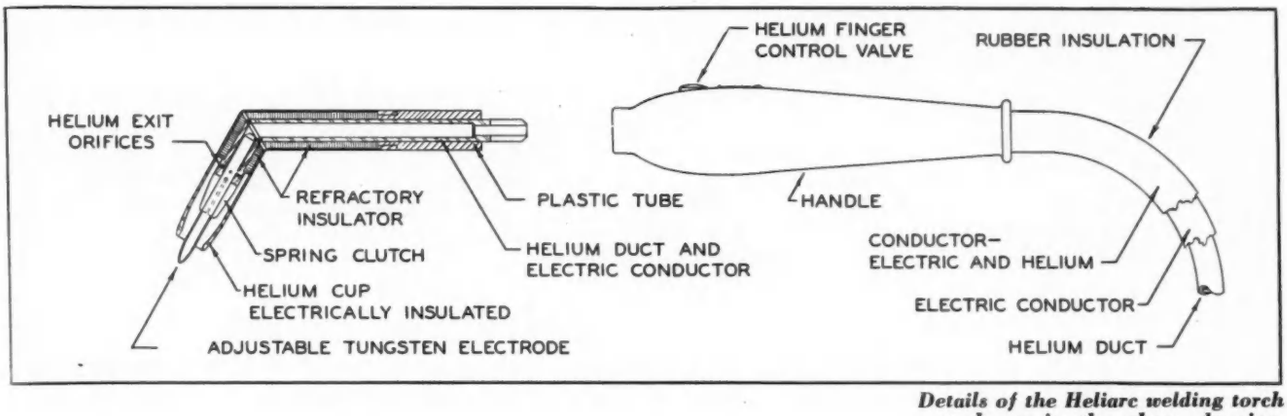
Circuit diagram of Heliarc welding torch.

The welding of magnesium in aircraft structures is of importance in that it eliminates the many thousand rivets in the conventional plane, and rivet heads, even when countersunk, produce considerably parasitic

The tungsten electrode is very slowly alloyed with the weld metal and must be replaced at intervals. There is no noticeable increase in the corrosion rate of Heliarc welds in magnesium alloys due to the presence of tungsten.

Heliarc weld ingots in general have very fine grain, and there is practically no grain enlargement adjacent to the bead, which indicates that the heating effect on the adjacent metal is not excessive. This accounts for the good welds obtained.

Dowmetal J-IH magnesium alloy, heliarc-welded, has approximately 95 per cent of the parent-metal strength in the weld area. However, at present the design safety factor for welded dowmetal J-IH assem-



Details of the Heliarc welding torch are shown in the above drawing.

blies is 75 per cent of the strength of the parent metal. These strength values are based on butt-welded joints. Fillet, lap, edge, or corner welds are weaker than the butt-welded joint, and must be stressed accordingly.

Heliarc welding has proven to be a successful method of joining parts of magnesium, stainless steel, brass, inconel, monel and some of the carbon-steel alloys. Research work is now in progress to extend its use to aluminum and to carbon-steel alloys not heretofore heliarc-welded. Since no flux is used, none can be entrapped and promote corrosion. The arc is produced directly between a tungsten electrode and the base metal, rather than between two tungsten electrodes, as is the practice in atomic-hydrogen welding.

Welding

The Northrop Heliarc welding torch is equipped with a helium valve that is opened just prior to the striking of the arc between the tungsten and the parent metal, which feeds helium through the torch to the weld. Helium has more than five times the specific heat of air, and when in motion it carries off heat rapidly, keeping the weld cooler and insuring better fusion and penetration, with less distortion, than other, welding processes. The arc is struck by a light brushing action and quickly drawing back from the metal. Northrop Aircraft, Inc., has designed heliarc torches which will shortly be available to the industry. The torches are to be in two sizes, handling 1/16 to ⅛ in. and 3/16 to 5/16 in. electrodes, respectively, and may be supplied with tips of different angles—40, 60 and 90 deg. The torch may be used for pencil welding, and also for heavier welding, for which latter purpose the handle is extended to give a handle-bar grip. It is planned to bring out a type of torch that will feed the filler rod automatically and give more uniform results than are obtainable with hand feed.

Best results are obtained by feeding the filler rod into the tungsten electrode, which melts off portions of the rod, thereby casting a uniform weld ingot. This procedure has been found to be superior to the practice of feeding the filler rod into the molten pool under the arc, as the molten pool then is not sufficiently agitated to break the crust which gathers on the surface of the pool. Since the reflected heat from the tungsten overheats the filler rod, an angle of 60 to 90 deg. must be maintained between the filler rod and

(*Turn to page 74, please*)

Heliarc welding of magnesium.

Part Two

Part One appeared in the September 1 issue of AUTOMOTIVE *and* AVIATION INDUSTRIES

Cars of the

PERHAPS the greatest developments will come in connection with engine design. It appears that for a given output the displacement and weight can be reduced in large proportion and the fuel economy vastly improved. Several basic trends point to the attainment of these objectives. One relates to improvements in fuel quality. The other is based on the fact that most engines now in production have about reached the limit of their development along established lines. The cost of tooling and foundry equipment will have been well amortized, leaving the engineering departments free to contemplate sweeping changes in design.

An estimate of the future was given by Dr. Gustav Egloff in a paper entitled "Motor Fuels of the Present and Future" at the Michigan-Life Conference in November, 1939. He first pointed to the expanding facilities for the production of 100-octane gasoline for military airplanes, and to the possibility of having such fuels available ultimately for passenger cars and other motor vehicles. He emphasized that with 100-octane gasoline, the airplane engine has approached the over-all efficiency of the best airplane diesel engine, which it excels in take-off and emergency power and in flexibility.

Dr. Egloff also commented on the fact that the art is tending toward the production of synthetic fuels composed of single hydrocarbons or of groups of three or four. Such fuels will be more nearly uniform in quality and will permit of better combustion control.

More conservative counsel, however, insists that even with the great expansion of facilities for the production of 100-octane gasoline for military use, the production capacity will fall far short of meeting the needs of the country's transportation system.

Anti-knock values of motor-car fuels have been on the increase in past years, especially between 1939 and 1941, as indicated by Fig. 1, a graph prepared by Ethyl Corp. It is reasonable to assume that current progress in petroleum technology and the availability of facilities for the production of 100-octane fuels will result in another major up-swing in the trend curve after the war. Moreover, it is logical to look forward to the availability of 100-octane gasolines for all purposes.

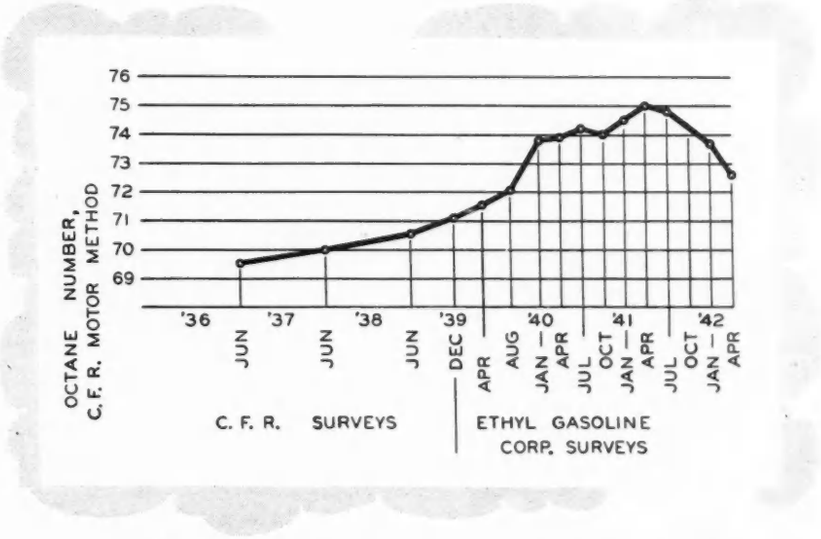


Fig. 1—Trend in antiknock value or regular grade gasolines sold in United States, 1936-1942

Ethyl Corp. has been doing a great deal of research work looking to improvement in engine design in keeping with improvements in fuels. They have explored two different courses of engine development, one involving the use of constantly increasing compression ratios to take advantage of the higher anti-knock values. This leads to maximum fuel economy but does not produce maximum power. The other—a more radical step reserved for the future — involves super-charging of all motor car engines. Part of the gain in output then is due to a moderate increase in the compression ratio, the remainder to supercharging. It is pointed out in this connection that supercharging in the conventional sense does not result in maximum fuel economy. There is, however, a way to get both more power and increased economy, and that is by the use of an engine of relatively small displacement, of high compression ratio as compared with current practice, fitted with a supercharger which starts operating only—automatically—when the throttle is fully opened.

Generally speaking, the net result of cooperative fuel and engine development will be the ultimate production of engines of about twice the present specific output and of greatly increased fuel economy. Engine weight will be considerably reduced, although not quite in inverse ratio to the increase in specific output. In the process of designing for increased specific output, due consideration will have to be given to structural strength and rigidity of load-carrying members such

Future

By Joseph Geschelin

Detroit Editor of AUTOMOTIVE *and* AVIATION INDUSTRIES and Vice President of Production Activity, Society of Automotive Engineers. This article is an abstract of a paper given by Mr. Geschelin at a recent meeting of the SAE Dayton Section.

as the crankshaft, crankcase, and connecting rods. This will be facilitated by the availability of high-strength alloys at reasonable cost. Thin-walled, heavy-duty bearings will play an important rôle in carrying the bearing loads of the engine of the future.

Some of the results obtained by Ethyl and the motor car companies indicate that there is a fairly definite limit to the maximum compression ratio that can be employed with an L-head engine. A ratio of 8 to 1 is about the limit, since breathing is adversely affected. This suggests that it may be necessary to swing to the valve-in-head engine, if and when compression ratios are stepped up to the values made practical by fuels approaching 100-octane.

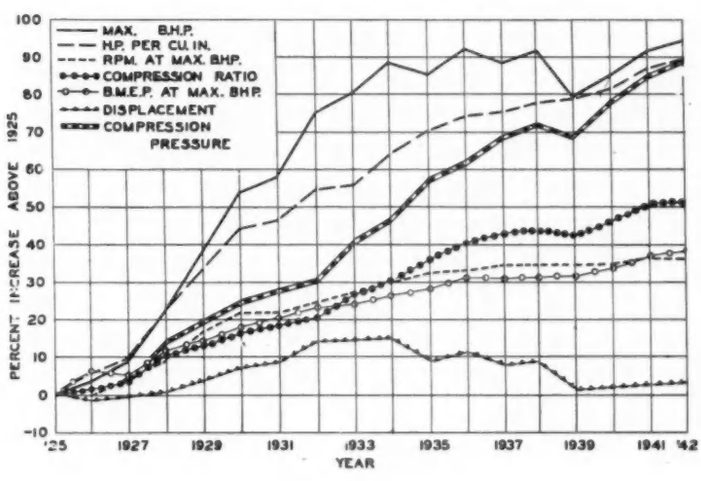


Fig. 2—Trends of American passenger car engine design since 1925

Lubrication, too, will be a major problem with high specific output engines. The lubrication system will have to be completely redesigned to ensure adequate flow and a satisfactory crankcase temperature.

Somewhere in the picture there may be a place for the two-cycle engine. If we consider supercharging for production engines we shall take a step toward the equalization of costs as between the four- and two-cycle design.

Now for some experimental evidence in support of the preceding generalizations. First consider the trends in passenger-car engine design, Fig. 2, as compiled by Ethyl Corp. Note particularly the trend in engine displacement. Although specific output has been constantly increasing, displacement has had a tendency to level off. Another basic trend is that of RPM at maximum BHP. This has been on the increase, although at a lower rate than the increase in output. Nevertheless, we must realize that increase in specific power during the past ten years has been due partly to increase in engine speed.

A paper by Dr. Graham Edgar, Ethyl Corp., entitled "The Manufacture and Use of Tetraethyl Lead," contains some facts in support of our contentions. Some of the evidence is based on tests made about five years ago by General Motors Corp., with an automobile equipped with a valve-in-head engine, in an elaborate project to determine the possibilities of increasing compression

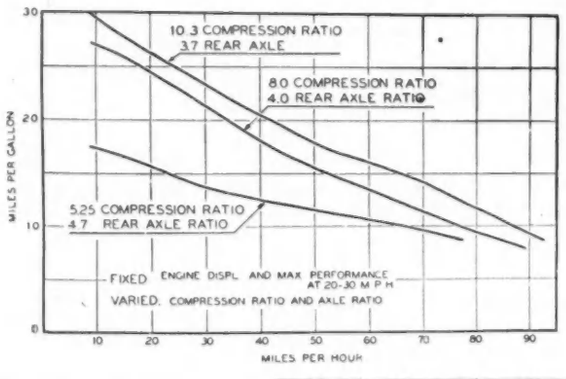


Fig. 3—Effect of increase in compression ratio on miles per gallon

ratio under conditions in which the anti-knock value of the fuel was no longer the limiting factor. Referring to Fig. 3 and quoting Dr. Edgar, "The car was operated both on the dynamometer and on the road at a number of compression ratios and a number of gear ratios, and fuels were used which in each case were just capable of avoiding knock. The octane numbers of these fuels are a little uncertain, since neither they nor the octane number requirements were determined by the conventional C.F.R. method, but approximately 69-octane fuel was required for the standard 5.25 compression ratio, about 95 octane number for 8.0 compression ratio, and something better than 100 octane number for 10.3 compression ratio. Fig. 3 compares the miles per gallon obtained by increasing the compression ratio when the gear ratio was adjusted until approximately constant low-speed performance was obtained (under these conditions the high speed performance was better with the high compression ratios).

"The results are striking and show, for example, that at 40 m.p.h. the m.p.g. improved from 12.5 at 5.25 compression ratio to 18 at 8.0 and 21 at 10.3. The average increase in economy, between 10 and 60 m.p.h. is about 45 per cent in going from 5.25 to 8.0 compression ratio under these conditions of constant performance."

In Fig. 4, Dr. Edgar shows the results of supercharging an 8-cyl. engine, the supercharge boost being 10 in. of mercury above atmospheric. The supercharged engine delivers almost double the horsepower of the same engine unsupercharged, using a suitable fuel to prevent knocking.

A valuable slant on the best set-up for maximum fuel economy is found in Fig. 5. Here Dr. Edgar shows the comparison between a large unsupercharged engine and an engine of one-half its displacement. The small engine is fitted with a supercharger which cuts in only when full throttle operation is required.

This comparison indicates that under the test conditions, the small engine has excellent fuel economy at part load—vastly superior to the economy of the large engine. When full throttle conditions are required, i.e., when the small engine must deliver excess power to match that of the big engine, the economy becomes the same as that of the large engine. This again emphasizes the point made earlier that supercharging alone does not enhance economy.

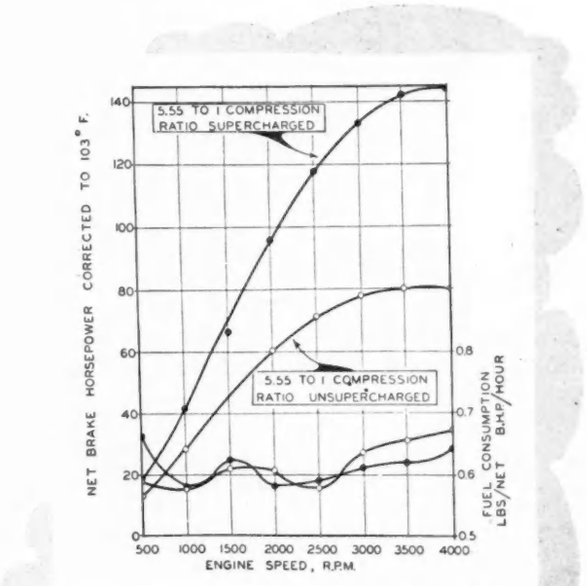


Fig. 4—Available brake horsepower for supercharged and unsupercharged engines

Another contribution along the lines of future possibilities is found in the paper, "Engineering for Better Fuel Economy" which was presented at the 1941 SAE summer meeting, by H. T. Youngren, chief engineer, Oldsmobile Division. He summarizes the avenues of potential engine improvements, as follows:

"1. Eliminating extraneous losses such as, improved engine design or reduction of engine speed to improve its mechanical efficiency, and reduction of rolling resistance.

2. Higher compression and expansion ratio when suitable fuels are economically available, then using the additional power output thus gained to reduce engine speed.

3. Optimum exhaust scavenging to prevent excessive dilution of the comparatively small fresh charge obtained at light throttle operation.

4. Adequate energy of spark to promote the firing of lean mixtures.

5. Best possible fuel atomization, delivering at part throttle such mixture ratios as are found to give maximum economy.

6. Ignition sufficiently early to develop a maximum explosion pressure at such time during the pressure stroke as to be most effective."

Safety—Comfort

Safety should be a major consideration in a discussion of the motor car of the future. One of its positive elements is the contribution of highway development. It is heartening to note that our vast network of major highways is constantly growing. Improved highway design, better surfacing materials, divided highways, improved lighting, these and other considerations all add up to improved safety on the road. I would point particularly to super-highway developments such as the marvelous Pennsylvania Turnpike as an example of what the future holds in store.

It must be noted that a streamlined body form as developed for rear engine cars provides some important safety features. The first of these is the excellent visibility for the driver due to his forward position. It is also possible to provide all the side vision that is necessary and to eliminate the blind spots.

Another basic aspect of safety is lighting—both of the highway and on the motor car. Val J. Roper, head of the division of automotive and aviation lighting at Nela Park, commenting on the headlighting problem,

proposes three avenues of approach as follows:

"First, continue with present sealed-beam design, hoping that as a greater percentage of registration is equipped and more drivers become familiar with the one standard headlamp system, satisfactory usage will naturally follow. This process may be hastened through intelligent education and enforcement. Later the light output may be stepped up to provide safer seeing—sufficient data are available to show just how much light is really needed.

"The second avenue of approach takes the task of "dimming," or depressing the beams out of the hands of the driver. As you know, automatic dimming is by no means a new idea, but it has yet to be proven practical. Recent developments justify increased hope on the part of its proponents. Working models of at least one reasonably-practical device are now under test. This is a photo-cell equipment with the cell and light collecting device mounted at the front of the car. A control inside—actuated by light picked up in front from approaching headlamps, operates the dimmer switch to depress the beam. The beams stay down until the driver steps on the foot switch to bring them up again. Naturally, a control of this kind on your car only helps the other fellow, until the majority of cars are equipped—unless drivers making such an installation were permitted to step up their own headlighting beyond present legal limits. In this event, there would be much more incentive to spend the cost of the automatic dimming equipment. Also it gives state officials an excellent means of permitting better headlighting.

What might be considered a variation of the automatic dimming idea is the dimmer switch control that requires constant pressure to keep the upper beam on. To drive with the upper beam, it is necessary to rest the foot (left foot) on the switch. Obviously, it is possible to work out a design that would require no great amount of pressure and hence would not tire the left foot any more than the right is tired by the accelerator.

The third approach lies in utilization of polarized headlamps. At the present writing, however, the Polaroid system has a number of basic drawbacks, stemming primarily from the fact that polarization absorbs about 40 per cent of emitted light.

I touch with some hesitation the matter of air-conditioning. The fact of the matter is that many sections of this country demand air-conditioning if the motor car is to compete with the railroads and buses. Early arguments against an air-conditioning installation have been dispelled by the signal success recorded by Packard. The Packard unit is self-contained, fully mechanical refrigeration system. It is not bulky and it is not too heavy. At present moment, the only bar to its installation as standard equipment is its prohibitive cost.

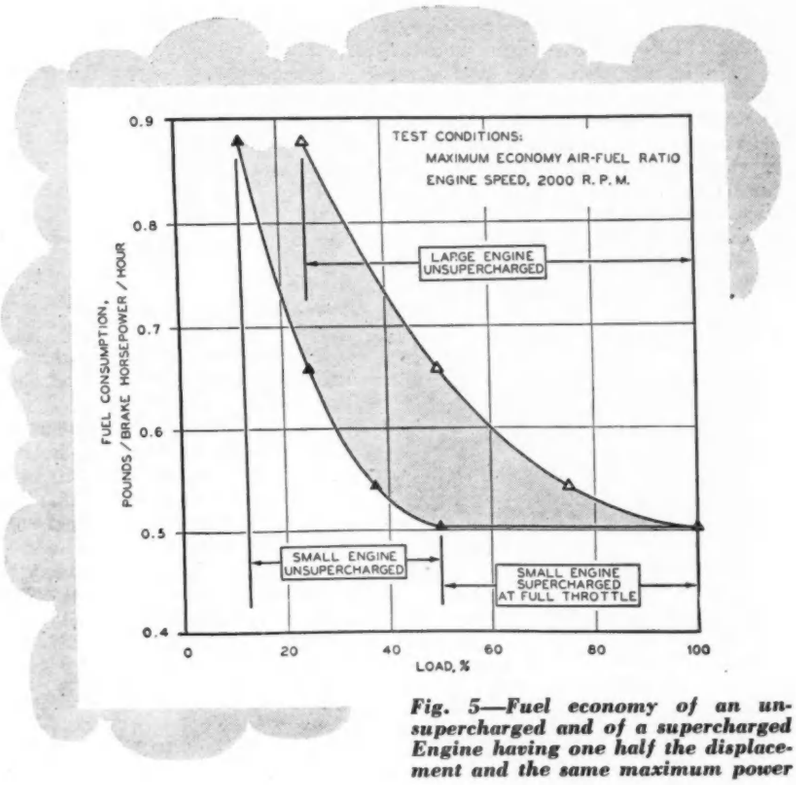


Fig. 5—Fuel economy of an unsupercharged and of a supercharged Engine having one half the displacement and the same maximum power

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Decline of the Long-Stroke Engine

Average stroke/bore ratio reduced from 1.44 to 1.28 during recent years

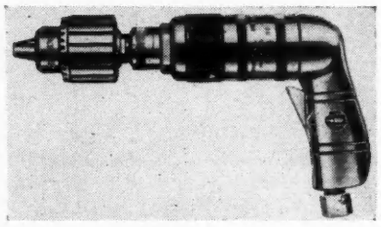
WE REMEMBER the time when the term "long-stroke" when applied to automobile engines was considered synonymous with "high-grade" and was part of the vocabulary of every automobile salesman. Looking over the AAI Statistical Number the other day we noticed in a table of "Sixteen Years Progress in Engine Design" that the average bore of passenger-car engines is the same this year (1942) as it was in 1927, viz., 3.26 in., but the average stroke has decreased from 4.68 to 4.18 in., so that the stroke/bore ratio has been reduced from 1.44 to 1.28. The trend in engine design has been entirely toward higher rotative speeds; with an increase in rotative speeds vibration difficulties increase, and these can be controlled by reducing the stroke. A short stroke, moreover, at least if it is not shorter than the bore, tends to reduce the weight of the engine. The one consideration that has tended to maintain the stroke-bore ratio is that in passenger cars multi-cylinder engines are preferred, and a multi-cylinder in line engine calls for a great amount of space on the chassis and reduces the passenger space for a given length of wheelbase.

MEN and

COMPLETE equipment for automatic arc welding with heavily coated electrodes has been announced by the General Electric Co., Schenectady, N. Y. In addition, elements of this equipment have been made available so that automatic arc welding heads originally designed for operation with thyratron-controlled coiled electrodes can be converted for successful welding with stick electrodes.

The equipment is particularly suited to work where one or more complete joints can be made with a single electrode, such as in the welding of shells, wheels and tubular assemblies where the starting and finishing ends of a single weld bead overlap.

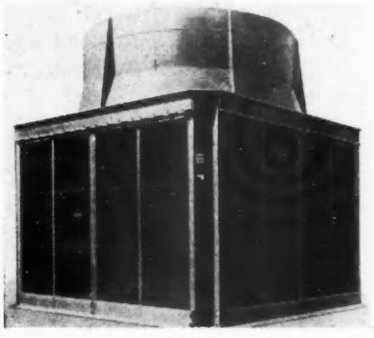
The equipment is similar to that used for welding with coiled electrodes except for the electrode feed rolls and electrode guiding device. The mechanism includes a clamp for holding any stick electrode and for transmitting current to the electrode. This clamp is attached to the end of a feed rod upon which two feed rolls operate to maintain the proper arc voltage through automatic thyratron control. The electrode is accurately guided to maintain the arc in a predetermined location. Limit switches govern the extremes of movement in either direction.



The Aro Equipment Corp., Bryan, Ohio, has added a new line of 3/8-in. capacity air drills in both straight and angle models. These drills are said to be suitable for a wide range of jobs in many war industries.

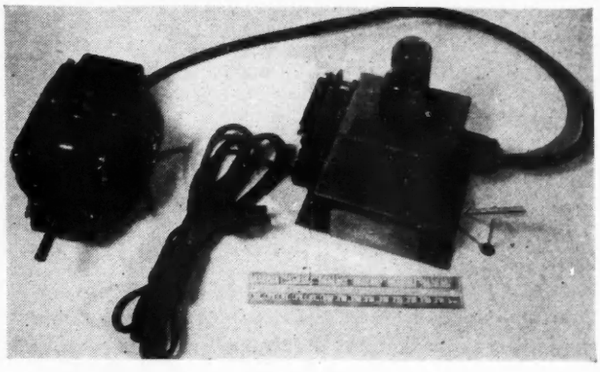
PINES ENGINEERING CO., Aurora, Ill., has added an automatic chute feed to the air chuck on its two-spindle profiling machine. This attachment is being used for feeding such items as brass and copper primer tubes for boring and tapping operations on both ends at the same time. According to the manufacturer, production from these machines has been increased as much as 30 per cent by the addition of this auxiliary.

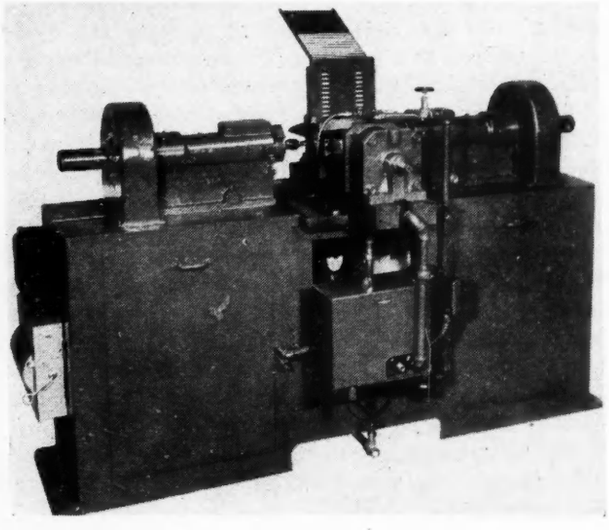
Pines profilers are being employed in war production for burring, chamfering, facing, threading, centering, reaming and boring both ends of tubes or rods for many pieces of war equip-



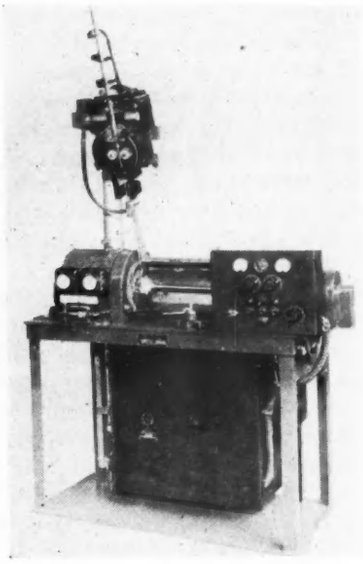
This new Young atmospheric cooling unit can handle the requirements of a 2000-hp Diesel.

Designed primarily to control the direction of rotation of conventional single-phase induction motors by means of electronic control circuits of negligible power, the Motron electronic control, offered by W. C. Robinette, Pasadena, Cal., may be applied to any split-phase or capacitor motor. It may also be applied to two-phase motors.





Pines profiler equipped with automatic chute for delivering rods or tubes to the air chuck.



General Electric equipment for automatic arc welding with heavily coated stick electrodes.

MACHINES

ment. In many instances several of these operations can be combined to expedite production.

THE Young Radiator Co., Racine, Wis., has developed a new four-sided cooling unit, the Quad, designed either to cool water, oil or gas, or to condense vapors.

Approximately 12 ft square and 14 ft high, the unit is capable of cooling a 2000-hp Diesel. Air is drawn through the heat transfer units by a horizontally mounted fan discharging through an especially designed discharge stack.

A number of these units are being built to handle the cooling requirements of compressors and to process vapors in several aviation gasoline by-product plants.

A NEW six-plunger, fully enclosed hydraulic pump has been added to the line manufactured by the Charles F. Elmes Engineering Works, Chicago, Ill. Completely equipped with roller bearings, the pump, driven by herringbone gears running in a bath of oil, has a maximum capacity of 400-hp. It is said to be particularly adaptable to connection to accumulator systems.

A NEW Lanco die head, type RXX, has been introduced by the Landis Machine Co., Waynesboro, Pa. Designed to handle diameters up to 12 in., the head consists of an oversize closing ring on which the offset chaser holders are mounted. It is said to be especially suitable for threading large diameter, fine pitch threads where thread lengths are relatively short.

THE Barcus shaft coupling, manufactured by the Barcus Engineering Co., Baltimore, Md., is designed to handle a total misalignment of 6 deg.

Consisting of two housing halves with integral internal gears and two hubs carrying gears cut on the central segment of a sphere, the coupling is built in four sizes to fit shafts ranging from 1¼ to 3 in.

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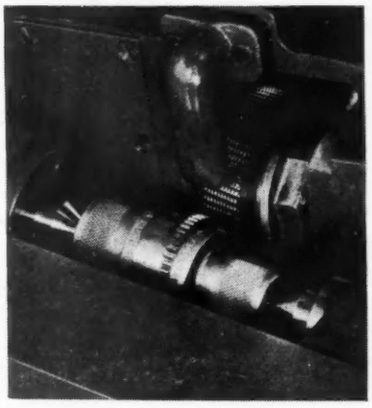
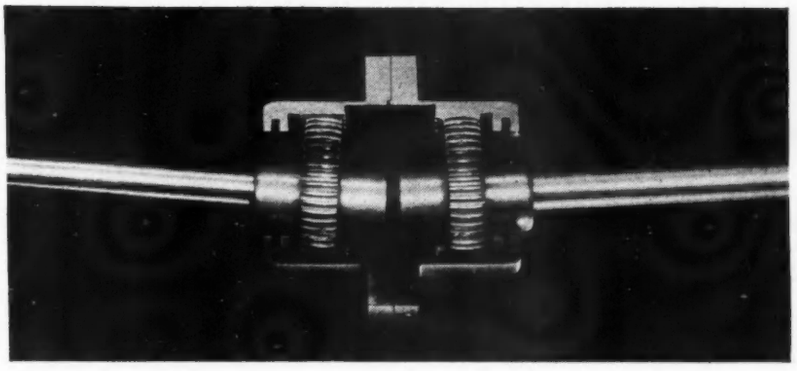


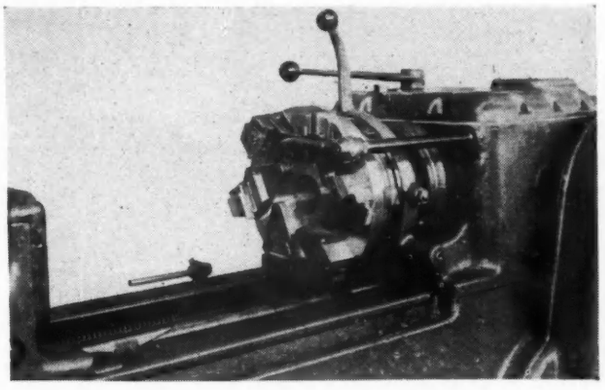
Close-up view of the Michigan model 861 gear finishing machine.



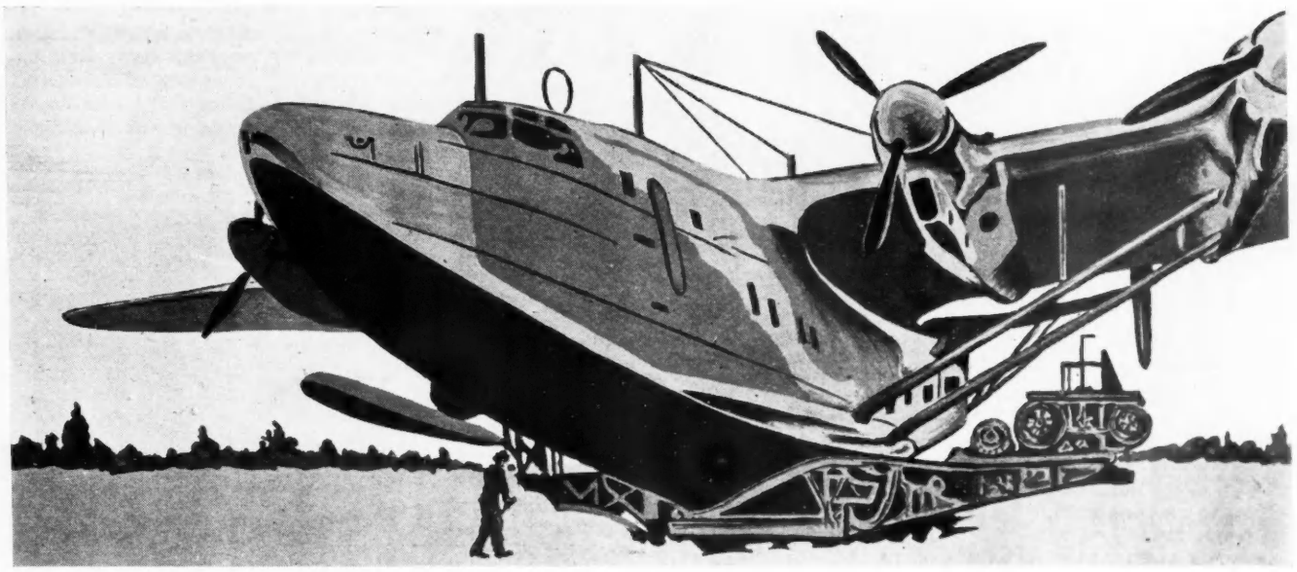
This Barcus self-aligning coupling will handle a maximum misalignment of 6 degrees.

This 450-ton hydraulic press, built by the Lake Erie Engineering Corp., Buffalo, N. Y., has been designed for molding phenolic plastics. It is furnished for direct connection to an accumulator pressure system, and is fitted with a 24- by 50-in. platen. It has a vertical stroke of 12 in., a horizontal stroke of 10 in.

Elmes six plunger hydraulic pump.



Lanco type RXX die head for cutting large diameter threads.



The Potez 161

SHORTLY before the fall of France, a French combine had nearly completed a large flying boat known as the Potez 161. But, with the coming of the German invasion, work on the plane was stopped until March, 1941, when the Germans consented to its completion.

The Potez 161 is an all-metal high-wing strut-braced monoplane fitted with retractable wing-tip floats. Six 1000-hp Hispano-Suiza engines propel the plane at a top speed of 220 mph. With a commercial load of two tons, its range at a speed of 134 mph against a 37-mph head wind is slightly greater than 3700 miles.

A number of its constructional details are of especial interest, some of which are shown in the two illustrations of the Potez 161 on this page.

Among these is a unique 78-foot runway along which the flight engineer, lying on a sliding platform, can gain access to the engines during flight.

Mooring equipment is housed in the nose of the plane. Next in order come the pilots' cabin, fitted with dual controls, and then the compartment shared by the navigator and the flight engineer. Radio equipment is installed in the latter compartment. From the flight deck a ladder leads to the companionway through the wings.

Five sections in the center of the hull make up the passenger compartments. The forward, fitted with a kitchen and two bunks, is reserved for the use of the crew. The next four, approximately 12 ft by 12 ft and 13 ft high, can be supplied with bunks for the accommodation of from 16 to 40 passengers. Each cabin, specially air conditioned to assure ventilation in the part of the hull above the gasoline tanks, is fitted with four windows. Dressing rooms and freight compartments are located aft of the passenger cabins.

The hull incorporates 12 watertight bulkheads, five of which in the center under the cabins contain the fuel tanks having a total capacity of about 7300 gal.

Loaded weight of the Potez 161 is listed at 94,900 lb and weight empty about 50,300 lb. The span is 150 ft

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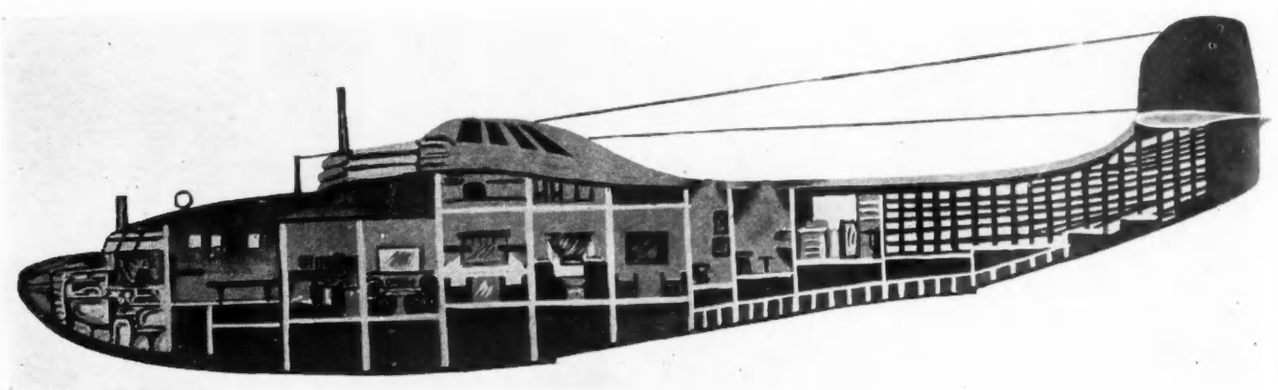


War Plants Report On Employment Gains

Expect Peak in Auto Industry by June, '43; Women Workers Swell Ranks; Labor Board Holds Hearing on GM Case

Employment in the automotive industry reached 823,888 workers in July, according to a report by R. L. Vaniman, chief of the Automotive Branch of WPB. This is still only 59 per cent of the anticipated war peak of 1,401,856 which will be reached when the ultimate capacity of the industry is achieved, probably by June, 1943. These figures are based on reports from 242 companies operating 686 plants and comprising 94 per cent of the industry. These plants were engaged 91.7 per cent on war work during July, the other 8.3 per cent being accounted for by remaining civilian production, including functional replacement parts.

The reporting companies added 54,317 employes in May, 40,081 new workers during June and 32,135 in July. General Motors Corp. alone has been adding 4000 new employes each week and as of Sept. 1 it had 305,000 workers on its U. S. payrolls, an all-time peak. The Automotive Branch based its employment totals on reports from nine automobile manufacturers operating 195 plants, 34 truck companies operating 42 plants, and 199 parts companies operating 449 plants. Of the July total of wage earners, $567,446, or 69 per cent were classed as production workers. Total employment of 470,931 in automobile and truck plants exceeds the peace-time peak of 443,000 reached in May, 1937.

"These figures show that the job of conversion in the automotive industry is near completion," said Vaniman in announcing the totals, "but a big job remains to bring employment and production to the anticipated peaks. To meet the anticipated peak of employment will present a definite labor supply problem, particularly in some areas such as Detroit. This problem had been foreseen and steps have been taken to meet it when the pinch comes. An illustration of this was the recent voluntary registration of women available for war work in the Detroit area."

In the Detroit survey 700,000 women were mailed questionnaires by the U. S. Employment Service. Of the first 160,000 classified up to Sept. 1, 53,000 or about one-third asked for factory jobs and claimed previous experience. Government officials expect 170,000 women to be available for manufacturing jobs in the Detroit area. Another 36,000 are expected to be available for non-factory work. A May survey showed that about 55,000, or 10½ per cent of the total employment of 521,000 workers in Detroit manufacturing industries, were women. The big problem will be to train the unskilled women for factory jobs.

General Motors is estimated to have about 25,000 women on its payrolls, or 8 per cent of total employment. Chrysler employs 6000 women, or 8 per cent of employment. About 10 per cent of the workers at the Ford Willow Run bomber plant are women. Hudson has only 3 per cent women workers but expects this to increase to 20 per cent. A novelty at Hudson is the hiring of 24 women as auxiliaries to the plant protection force. All are over 5 ft 10 in. tall and are employed to escort visitors through the plant grounds. Briggs Mfg. Co., engaged in airframe production work, lists 20 per cent of its employes as women but eventually this may rise to 50 per cent.

California aircraft plants are large employers of feminine labor. Consolidated Aircraft Corp. alone employs more than 7500 women. All California manufacturing industries had 76,000 women on the payrolls in June and in recent months the proportion has been one woman hired for every 4½ men. In aircraft plants the women are particularly adept at riveting, welding, and electrical work. Douglas Aircraft Co., Inc., is opening a plant nursery to care for the children of women workers.

In hearings before the War Labor Board on the recommendations of the three-man panel in the contract dispute between General Motors and the UAW-CIO, Harry W. Anderson, GM vice-president, revealed that the 5-cent-per-hour and other wage increases recommended by the panel would add about $52 million to the cost of GM war products in 1942 and $118 million to the cost of such products in 1943. Although only 5 cents per hour additional was recommended by the panel in straight time costs, the over-all post per man-hour adds up to 12.7 cents. This in-

(*Turn to page* 64, *please*)

Hutchins New Regional Director

Appointment of Daniel Joseph Hutchins, Detroit, as Regional Director of the War Production Board with headquarters in Detroit, was announced recently.

Mr. Hutchins joined the staff of the Automotive Branch of the War Production Board in February of this year, and in May he became chief assistant to Ernest Kanzler, who was then Detroit Regional Director. Before joining the WPB staff, Mr. Hutchins was Detroit district manager for the Firestone Tire and Rubber Company.

Report on Outlook For Synthetic Rubber

At a meeting on Sept. 9 of the American Chemical Society in Buffalo, Dr. Albert L. Elder, technical adviser of the WPB, predicted the production of 325,000 short tons of Buna S synthetic in 1943, 975,000 tons in 1944. This prediction was based on the estimated annual production of butadiene plants now under construction.

In addition to 717,800 tons of butadiene, 239,000 tons of styrene, the other principal ingredient, must be produced to attain this total. No figures on the output of other types of synthetic were given.

Another appraisal of the synthetic situation, the Baruch report made public on Sept. 10, stressed the narrow margin between the estimates of essential needs for 1943 and the probable production of synthetic for the same period.

The following figures were released:

On hand July 1, 1942 (stock pile) —578,000 tons

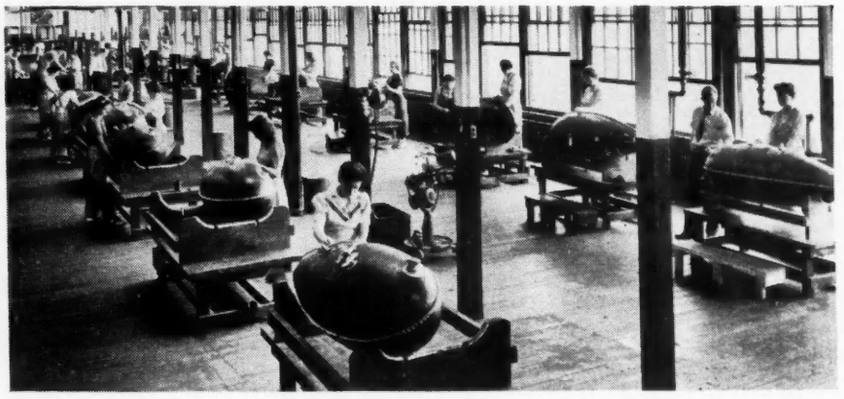
Estimated imports from July 1, 1942, to Jan. 1, 1944—53,000 tons

Total crude rubber—631,000 tons

Estimated military and other essential demands, July 1, 1942, to Jan. 1, 1944, with no allowance for tires for passenger automobiles—842,000 tons

Deficit which must be met by production of synthetic rubber before Jan. 1, 1944—211,000 tons

The Baruch report stated: "If our hopes are realized, the production of Buna S and neoprene . . . will total 425,000 tons by the end of 1943. It emphasized, however, the tragic results of a possible curtailment in production induced by unforeseen difficulties.



Spare Fuel Tanks

Working in part with converted tire machinery, engineers of the United States Rubber Co. have developed methods for producing these streamlined spare fuel tanks which are used to extend the range of many types of aircraft.

Parts Given Higher Rating by New Amendment

Manufacturers May Now Request AA-2-X Ratings, Highest Applied to Civilian Output; New Subcommittees Formed

Functional replacement parts are given an even better preference rating than heretofore under an amendment to Limitation Order 158 issued Sept. 1 by the Automotive Branch of the War Production Board. By the terms of the amendment producers may schedule their production of replacement parts as if they bore a rating of AA-2-X. Previously, the top rating for such production was A-1-a. The AA-2-X preference is the highest rating that can be applied to civilian production. It is exceeded only by the special AAA ratings and the AA-1 and AA-2 classifications, which are reserved for Army and Navy use.

Producers still are limited in the quantity of material which can be purchased to fill rated or unrated orders by the amounts authorized on their PRP certificates. However, producers may make special requests for reratings of material required in the third quarter on special PD-25-F certificates and ratings up to AA-2-X may be granted by the Automotive Branch.

Production of storage batteries for replacement use in motor vehicles in the six months from July 1 to Dec. 31 is limited to 90 per cent of such output in the same period of 1941 under the terms of Limitation Order 180 announced Aug. 29. This supercedes Orders L-35 and L-4-b. However, producers still are limited to a 60-day inventory of batteries, based on the corresponding period of 1941. A used battery of the same size or larger must be turned in by each consumer buying a new or rebuilt battery. Previously, no size was specified for the turn-in battery.

The production order is more liberal, as under L-4-b a producer was limited to 75 per cent of his 1941 production for the period from April 1 to Sept. 30, 1942. Now this is increased to 90 per cent effective July 1, 1942.

Four subcommittees of the Automotive Replacement Parts Advisory Committee have been appointed by the WPB. These committees—engine parts, electrical and fuel, driving parts and heavy truck and bus—will work with the WPB and the main advisory committee on specific problems which may arise in their particular fields.

The committees are:

Engine Parts—Burke Patterson, Thompson Products, Inc., chairman; Ralph Teetor, Perfect Circle Co.; Robert Cass, White Motor Co.; C. W. Johnson, Cleveland Graphite Bronze Co.; H. W. Knapp, McQuay-Norris Mfg. Co.; D. W. Rodger, Federal-Mogul Corp.; O. W. Brown, Wisconsin Machinery & Mfg. Co.

Electrical and Fuel—V. E. Doonan, Ford Motor Co., chairman; A. G. Phelps, Delco-Remy Division of GM; L. H. Middleton, Electric Auto-Lite Co.; Hugh H. C. Weed, Carter Carburetor Co.; R. H. Rowland, Champion Spark Plug Co.; J. E. Echlin, Echlin Mfg. Co.

Driving Parts—C. E. Hamilton, Automotive Gear Works, Inc., chairman; G. C. Gridley, Mechanics Universal Joint Division of Borg-Warner Corp.; F. W. Parker, Timken-Detroit Axle Co.; D. F. Kalish, Spicer Mfg. Co.; T. R. Navin, Republic Gear Co.

Heavy Truck and Bus—Max Miller, Yellow Truck & Coach Mfg. Co., chairman; R. F. Koch, International Harvester Co.; T. E. Waterfall, Chrysler Corp.; W. L. Davis, Twin Coach Co.; L. J. Bennett, Mack Mfg. Corp.; F. G. Allen, White Motor Co.; J. H. Hunt, Motor Wheel Corp.

Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE AND AVIATION INDUSTRIES**

Narrow fluctuations of general business activity continue. The seasonally adjusted index of *The New York Times* for the week ended Aug. 29 rose to 132.6 per cent of the estimated normal from 131.6 for the preceding week, as compared with 130.2 a year ago. The index of *The Journal of Commerce*, without seasonal adjustment, for the same period stands provisionally at 127.6 per cent of the 1927-29 average, equivalent to the peak established last October, as against 126.6 for the week before.

Department store sales during the week ended Aug. 29, as reported by the Federal Reserve Board, were 14 per cent below the comparable level last year; and for the four weeks then ended sales averaged 6 per cent less than the corresponding amount a year earlier.

Railway freight loadings during the week ended Aug. 29 totaled 899,419 cars, 3.5 per cent more than the number for the preceding week but 1.5 per cent below the comparable figure in 1941.

Electric power output declined more than seasonally in the same period and was 11.6 per cent greater than a year ago, as against a similar excess of 13.7 per cent a week earlier.

Crude oil production during the week ended Aug. 29 averaged 3,964,350 barrels daily, 7350 barrels below the figure for the preceding week and 74,150 barrels less than the average output recommended by the Office of the Petroleum Coördinator.

Average daily production of bituminous coal during the week ended Aug. 22 was 1,821,000 tons, as compared with 1,858,000 tons for the week before and 1,792,000 tons a year ago.

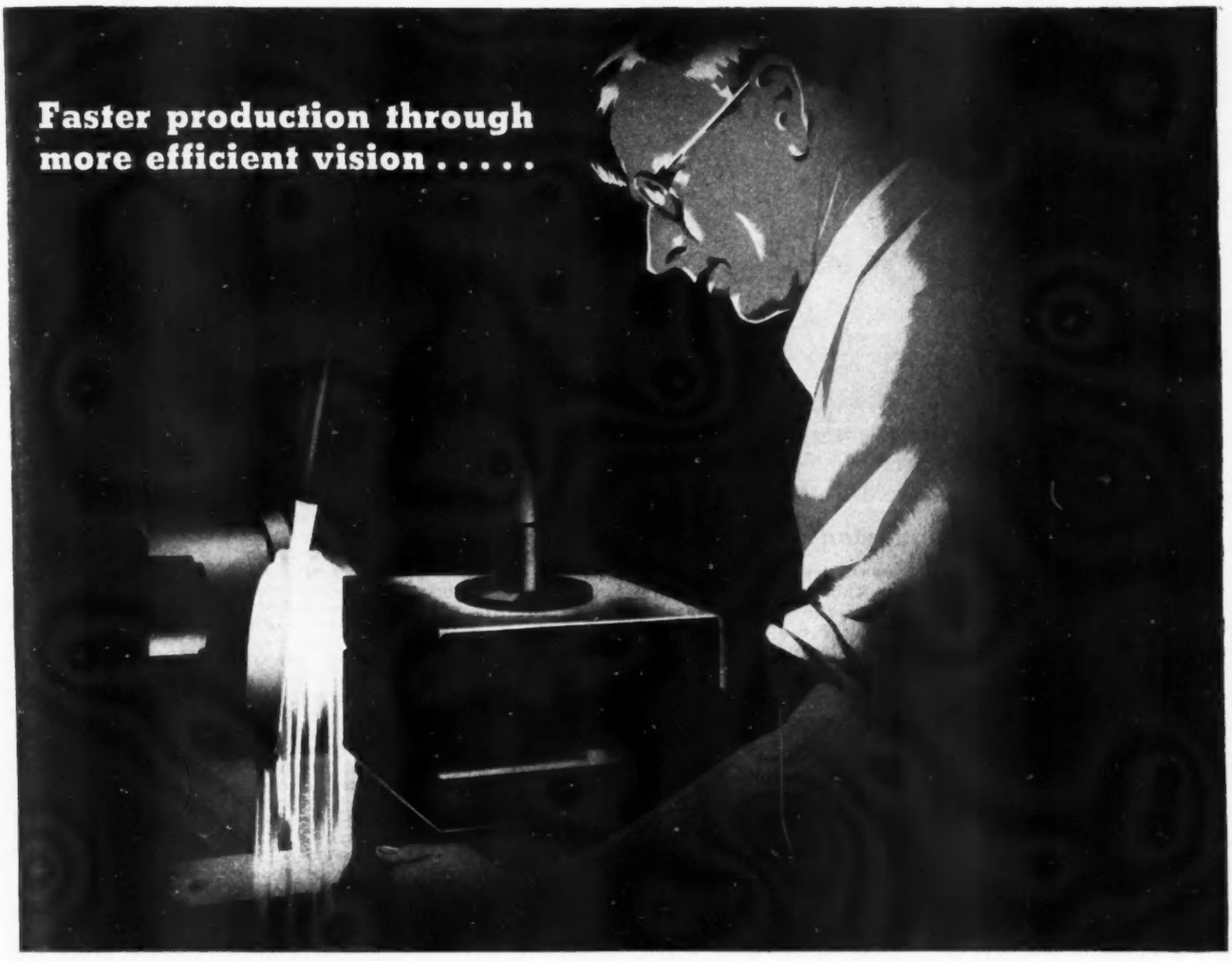
Engineering construction contracts awarded in the week ended Sept. 3 exceeded $200 million for the fourth consecutive week, according to *Engineering News-Record*. For 1942 to date, the total is 62 per cent greater than the corresponding amount in 1941—with public work 92 per cent higher than a year ago, as against a drop of 51 per cent in private contracts.

Professor Fisher's index of wholesale commodity prices for the week ended Sept. 4 declined to 107.2 per cent of the 1926 average from 107.4 for the preceding week.

Member bank reserves declined $108 million during the week ended Sept. 2, and estimated excess reserves decreased $80 million to a total of $2,260 million. Business loans of reporting members declined $47 million in the preceding week and stood $160 million above the total a year earlier.

George W. Walker

George W. Walker, 75, retired chemist and metallurgist, died Sept. 5 at his home in Detroit. He formerly was chief chemist for the Hupp Motor Car Co. and for 12 years previous to his retirement in 1938 he was a metallurgist with the Chevrolet Motor Division of GM. He was a contributor to several technical publications.



Information supplied by "The American Weekly"— Mr. R. D. Potter, Science Editor

More and more wartime conditions are bringing men over 40 into high-speed or close tolerance industrial work. Many of these have eyes not quite up to the job. Under peacetime conditions this defect is not of vital importance, but today with every nerve strained to increase production, it is serious.

Some industries are giving mass eyesight examinations seeking to find those employees needing glasses or optical corrections in the glasses they now have. Still others take the added precaution of endeavoring to fit the job to the type of eyesight available for it — near-sighted people may be excellent on close work such as bomb sight assemblies, whereas far-sighted people would be better suited to work on a large lathe where micrometer readings must be made at distances as great as 30 inches. Following this thought further some companies have employed special occupational eye glasses ground to fit the working conditions of the employee.

Efficient eyesight is the backbone of fast, accurate production. It will pay Industry to further it by every means possible.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY

Wide World

Laister-Kauffmann Training Glider

This photograph shows several constructional details of the training glider designed by Jack Laister (rear cockpit), president of the Laister-Kauffmann glider company. The framework of the fabric-covered fuselage consists of welded steel tubing; the frameworks of the wings and control surfaces, also fabric-covered, are constructed of wood. It is said that this type will be used by the Army Air Forces for the training of pilots in advanced glider schools.

Steel Shortages Persist, Despite Re-rating

New System Expected Shortly to Provide Adequate Flow to War Industries; Armed Services Drain Labor Supply

By W. C. Hirsch

It will take some time before the effect of the changeover in the system of rating steel orders, which is now under way, can be properly evaluated. For the present, re-rating happens to be the nearest-at-hand "out" when this or that steel consumer complains of delays in shipment or inability to get a promising place on mills' unfilled order books.

The objective of re-rating is to obtain control of the flow of steel during the year's last quarter to insure adequate supplies to plants with vital war contracts. It is hoped that, once the new system is in working order, many of the rough spots that have developed in the last few months will be smoothed out, but it is recognized at the same time that in a war economy changes in control methods must be expected and that it is foolish to expect regulations that can be looked upon as permanent. Intimations from Washington that before long OPA regulations would be simplified in language, legal phraseology being avoided as much as possible, evoked much gratification among steel consumers.

There has been some improvement of late in sheet bar deliveries to non-integrated rolling mills, which have been enabled thereby to step up their operating rates. Whether this change will continue remains to be seen.

Loss of skilled labor to the armed services is beginning to worry all branches of the metal industry. Curtailment in output of some kinds of steel has released a number of workers in these departments, many of them highly skilled operatives in their particular field, but of no more than ordinary ability when transferred to tasks in other departments. Employment managers fear that dispersal of such specialists will impose a heavy burden on the industry in the future.

The supply of labor in copper mines is running low, and in some quarters it has been suggested that men, now employed in gold mining properties, should be induced to seek employment in mines producing the more necessary base metals. One of the large metal producers is expected to start producing high-grade zinc in a new plant in the Southwest in the near future. This addition to the supply of die casting material is expected to ease the tension. Foreshadowing the greater availability of zinc in the near future, buying prices for secondary material have already dropped fractionally in some markets.

Edwin L. Smalley

Edwin L. Smalley, president of the Hevi Duty Electric Co., died in Milwaukee, Wis., Aug. 29, at the age of 65.

MEN . . . . . .

Jack P. Horner, former West Coast manager of the aeronautical division of the Firestone Tire & Rubber Co., has been appointed to the engineering service staff of Adel Precision Products Corp., Burbank, Cal.

Wallace T. Montague has been elected vice-president in charge of sales planning and development by the directors of the Norton Co.

James H. Rasmussen has been appointed director of automotive activities of The Crosley Corp.

George E. Price, Jr., former Goodyear purchasing agent, has been ordered to active duty as a lieutenant colonel in the U. S. Army, Services of Supply.

Willard S. Crandall has been named director of engineering for The Fostoria Pressed Steel Corp. He succeeds Lieutenant Ray N. Green, who has entered the Army.

W. J. Reagan has been appointed melt shop research metallurgist of the Copperweld Steel Co.

J. T. Callahan has been named western district sales manager of The B. F. Goodrich Co. succeeding **Walter W. Thomen,** who has been called to active service as a major in the office of the Chief of Ordnance, War Department.

Carl J. Kennedy has been appointed sales manager and assistant secretary-treasurer of Hydraulic Machinery, Inc.

William B. Prosser, former equipment sales manager of the Perfect Circle Co., has been transferred to the company's new Indiana plant as plant manager. **W. J. Cramer,** former plant engineer, has been named factory manager. Other executives of the new plant are: **W. J. Stahr,** personnel manager; **E. H. Fosnight,** production superintendent; **A. H. Webber,** office manager; and **W. H. Skinner,** purchasing agent.

R. J. Laidlaw has been named manager of

(*Turn to page* 62, *please*)

CALENDAR

Conventions and Meetings

Automotive Electric Assoc. Mfg. & Distb. Divs., Chicago.....Sept. 24-25

SAE National Aircraft & Production Mtg. Los Angeles .....Oct. 1-3

SAE War Transportation and Maintenance Mtg., New York City, Oct. 7-8

Natl. Metal Congress & Exposition, Cleveland .....Oct. 12-16

American Welding Society, Detroit, Annual Mtg. .....Oct. 12

American Society of Tool Engineers, War Production Conference, Springfield, Mass. .....Oct. 16-17

SAE National Fuels & Lubricants Mtg., Tulsa .....Oct. 22-23

Natl. Lubricating Grease Inst., New Orleans, Annual Mtg. .....Oct. 25-29

Natl. Safety Congress and Exposition, Chicago .....Oct. 27-29

Natl. Safety Council, Chicago, Annual Mtg. .....Oct. 27-29

Natl. Industrial Chemical Conf. & Exposition, Chicago .....Nov. 17-22

American Petroleum Inst., Annual Mtg., Chicago .....Nov. 9-13

Amer. Society of Mechanical Engrs., New York City, Annual Mtg. Nov. 30-Dec. 4

Highway Research Board, St. Louis, Mo. .....Dec. 2-4

SAE Air-Cargo Engineering Mtg., Chicago .....Dec. 8-9

SAE War Production-Engineering Mtg., Detroit .....Jan. 13-15

National Defense REQUIRES CORK, COPPER AND ALUMINUM

DO NOT SCRAP USED GASKETS!

RESURFACE used, undamaged gaskets with Permatex Form-A-Gasket Number 2 or Permatex Aviation Form-A-Gasket Number 3.

Cracked or broken gaskets should be repaired first with Permatex Form-A-Gasket Number 1.

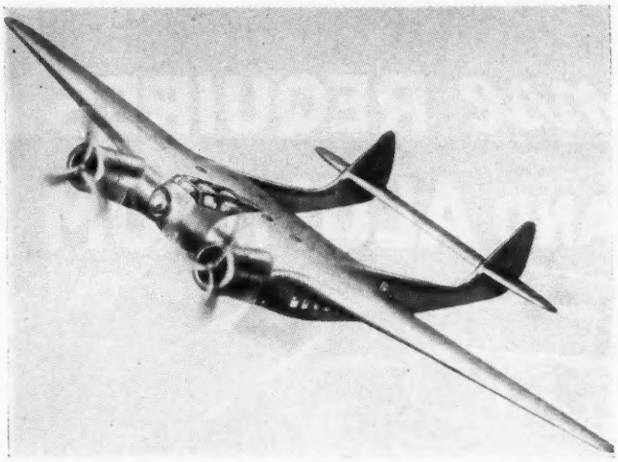
Permatex Form-A-Gasket Number 1 dries fast, sets hard and gives strength to any gasket or assembly.

Permatex Form-A-Gasket Number 2 dries slowly, remains pliable and preserves all types of gaskets from thinnest cork to heaviest copper.

Permatex Aviation Form-A-Gasket Number 3 does not dry and does not run, although applied with a brush. Fine on cylinder head gaskets because it prevents corrosion and head seizure.

All of the three types of Permatex Form-A-Gasket make assemblies leakproof to gasoline, gasoline vapor, kerosene, hot or cold lubricating oil, fuel oil, grease, hot or cold water, salt water and cooling system solutions containing any standard type of anti-freeze.

PERMATEX COMPANY, INC.
Sheepshead Bay, N. Y., U. S. A.



Flying Fuselage

The lifting fuselage or all-wing type of aircraft has long been considered as one possessing desirable aerodynamic qualities. This design has been proposed by Canadian Car and Foundry, sole Canadian licensees under the basic Burnelli patents.

Kanzler Appointed As Director General

Donald M. Nelson, chairman of the War Production Board, announced on Sept. 2 the appointment of Ernest Kanzler as Director General for Operations.

Mr. Kanzler succeeds Amory Houghton who has resigned as of Sept. 15, to return to his position as chairman of the board of the Corning Glass Works, Corning, N. Y. Mr. Kanzler, who has been serving as Deputy Chairman on Program Progress, will have supervision in his new post over all operations of the War Production Board carried out through industry branches and materials branches.

Establish Canadian Priorities Division

Establishment of a Canadian Division to handle Canadian priorities problems in the Office of Operations of the War Production Board was announced on Aug. 31 by Amory Houghton, Director General of Operations. Joe Tucker will be director of the new division, with headquarters located with the Department of Munitions and Supply, Ottawa, Canada.

As previously announced, Canadian companies engaged in war production are now eligible to receive priorities assistance in obtaining materials from the United States under the Production Requirements Plan or, upon special authorization, under the various preference rating orders applicable to similar American companies.

Perfect Circle to Operate New War Plant

Perfect Circle officials have announced the building of a new war plant, in Indiana, which will be financed by the Defense Plant Corp. and operated by The Perfect Circle Co., Hagerstown, Ind.

PUBLICATIONS

The B. F. Goodrich Co. has just published a 30-page **Rubber Guide Book for American War Industries.** It lists the application and properties of many types of products for industrial and aeronautical purposes using natural, synthetic, or reclaimed rubber. Well illustrated, the booklet is divided into 11 indexed sections.*

Hercules Powder Co. has issued a new 21-page booklet discussing the properties and applications of a series of **terpene solvents.** It also includes technical graphs on A.S.T.M. boiling and distillation ranges, etc.*

A new catalog, describing its entire line of **engine, toolroom, and turret lathes,** has just been published by South Bend Lathe Works. Illustrations, descriptions, and specifications are included for each size and type of lathe.*

Overarm Automatic Turning and Boring Machines are described and illustrated in an 8-page booklet just issued by Overarm Machine Co.*

Bakelite Corp. Unit of Union Carbide and Carbon Corp. has just published a booklet, **Bakelite Laminating Plastics,** describing the various types, including molded-laminated stock, engraving sheet stock, fluorescent and phosphorescent sheet stock, etc. It contains photographs showing the manufacture of laminated materials and their essential uses in electrical, automotive, aircraft, and chemical industries.*

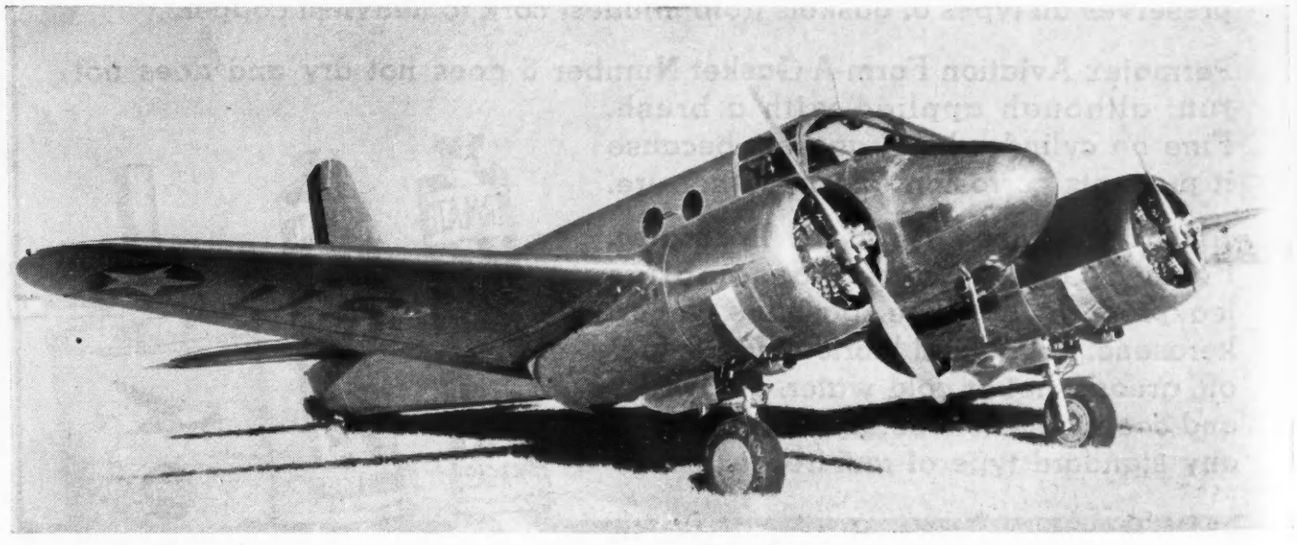
Vinylite Resins, Their Forms, Properties and Uses is the title of a new 20-page illustrated booklet just published by the Plastics Division, Carbide and Carbon Chemicals Corp. It describes briefly the four major types of vinyl resins and the various plastic materials produced from them.*

Resistoflex Corp. has issued three new booklets: an **aircraft catalog,** illustrating, describing, and giving specifications of various types of hose; an **automotive catalog,** giving prices, specifications, etc., of hose and oil filter assemblies; and an **industrial catalog,** giving information about its various types of hose, tubing, and mechanical molded goods.*

Oakite Products, Inc., has just published a manual on **plant sanitation.** It discusses effective war-time sanitary measures and good housekeeping routines for use in aircraft, engines, and accessory manufacturing plants.*

Neoprene Notebook No. 33, published by

(*Turn to page* 62, *please*)



Beechcraft Bomber-Pilot Trainer

Even the fuel tanks of this Beechcraft AT-10 are made of wood lined with a leakproof material. The use of plastic-bonded plywood in many major assemblies permits the letting of sub-contracts to both furniture and piano makers.

Simplex Milwaukee Milling Machine—a compact, medium size machine for efficient production of smaller parts.

KEARNEY & TRECKER
CORPORATION

The machine tool industry has established new records in war production by producing machines in quantities without sacrificing accuracy and quality . . . Kearney & Trecker has developed many such machines, among them the M-Series Simplex—the newest machine in the bed type field.

It answers the demand for a medium-sized machine to efficiently produce the thousands of small parts vitally needed for planes, tanks and guns. Because its basic design is the same as the larger machines, it has strength and ruggedness to spare.

KEARNEY & TRECKER CORPORATION • Milwaukee, Wisconsin, U. S. A.

Milwaukee MACHINE TOOLS

Additional Awards To Automotive Plants

A number of additional automotive plants have been awarded the Army-Navy "E" for war production achievements. Four divisions of General Motors Corp. have been so honored—AC Spark Plug at Flint, Saginaw Steering Gear at Saginaw, Guide Lamp at Anderson, Ind., and Delco Products at Dayton. Autocar Co., Ardmore, Pa., has been granted the award for producing half-trac armored cars and other mechanized equipment. Other winners include the Ex-Cell-O Corp., and Micromatic Hone Corp., both of Detroit; the Goodyear Tire & Rubber Co., Plant 3, Akron, Ohio; Federal Motor Truck Co., Detroit; Monroe Auto Equipment Co., Monroe, Mich.; the Connors plant of Briggs Mfg. Co.; and the Detroit plant of Eaton Mfg. Co.

Six units of the Chrysler Corp., the Lynch Road, Highland Park, Plymouth, Dodge, DeSoto, and the Jefferson Avenue plants, also received the award.

Move Headquarters

Production Devices, Inc., has announced the removal of its headquarters office from East Hartford, Conn., to its new plant at Poultney, Vt.

Plastics Production Up

Production of "Lucite" methyl methacrylate plastic for transparent sections of military airplanes during the first six months of 1942 nearly quadrupled that for the comparable period of 1941, the du Pont Company announced recently.

Three-quarters of all the plastics it expects to produce this year are developments which emerged from the research laboratories within the past five years, the company said.

Take Over Plant For Parts Production

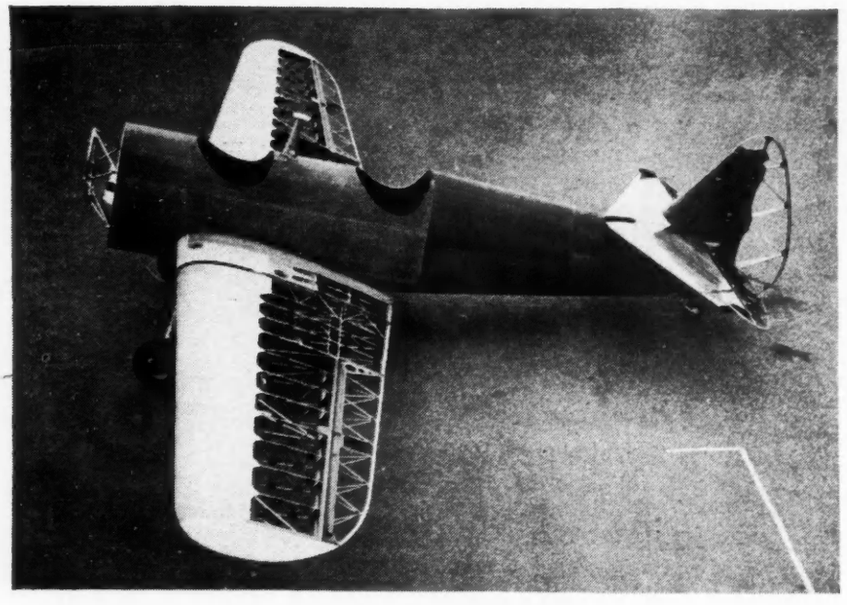
Northern Aircraft Products Division of Aviation Corp. has taken over a plant in Toledo for the manufacture of hardened and ground parts for aircraft engines. This is the third subsidiary of Aviation Corp. to be located in Toledo; the American Propeller Corp. and the Liquid-Cooled Engine Division are already established there.

Triples Output

Through the erection of several new plants, floor space of The Ready-Power Co., Detroit, Mich., has been increased approximately 600 per cent, according to H. D. Gumpper, president of the company. The production of Ready-Power gas-electric power plants for industrial truck operation is now more than three times greater than it was at the beginning of 1941, he said.

Charles A. Lewis

Charles A. Lewis, 55, asisstant director of public relations for General Motors Corp., died Sept. 7 at his home in New York after a long illness.



Ryan Plywood Trainer

On contract for the U. S. Army, the Ryan Aeronautical Co. has completed this new plastic-bonded plywood trainer in which aluminum alloys and all strategic materials are said to have been eliminated, with the exception of the engine cowling which represents less than two per cent of the total weight. Powered by a Lycoming 185-hp 6-cylinder horizontal opposed engine, the plane has a top speed of approximately 150 mph, a service ceiling of about 20,000 ft, and a rate of climb of 1590 fpm at sea level. It has a wing spread of 32 ft 10½ in., and is approximately 24 ft 4 in. long, 6 ft 3 in. high. All exterior surfaces are protected by a lightweight fabric applied over the smooth plywood skin.

BOOKS . . .

TORQUE CONVERTERS OR TRANSMISSIONS, *by P. M. Heldt. Published by P. M. Heldt, Nyack, N. Y.*

In recent years the emphasis in automotive development has shifted from engines to transmissions, undoubtedly because in the field of the latter a state of finality is being approached where further efforts are likely to yield only meager returns. The automatic transmission for passenger cars has long been an alluring engineering problem, and the appearance of the traffic-type of coach with the powerplant located at a considerable distance from the driver's seat has made the conventional geared transmission more or less impractical in that field.

Quite a number of new transmissions and "drives" therefore have been developed in recent years, of which the hydraulic or fluid drive probably has received most attention. The planetary transmission, which was thought to have become obsolete when the Ford Model T was abandoned, has staged a comeback in the Warner automatic overdrive and the G.M. Hydromatic transmissions. Then, of course, we have the electric drive which, while of rather remote origin, has gained greatly in importance in recent years because of its practically exclusive use with Diesel engines in buses and locomotives; also pneumatic drives which are under development abroad for use in locomotives, chiefly as a conversion proposition, and the various kinds of automatic and continuously-variable transmissions on which inventers have been engaged during the past two decades.

All of these different transmission types are covered in Mr. Heldt's new book. The conventional geared transmission is dealt with strictly from a design standpoint, different possible lay-outs, desirable gear ratios, materials used and their heat treatment, and strength calculations being discussed in detail. In the case of the newer

(*Turn to page* 60, *please*)

40 YEARS AGO

An engineer of the German army has recently made a report upon the possible advantages of motor vehicles in warfare. Dealing with the economics of the question, he shows that a traction engine of from 20 to 30 horse power and of a total weight not exceeding 9 tons could easily draw five heavy cars at a speed of about 4 miles per hour on rough roads and of 8 miles on level roads, with great facility. Thus twenty-one horses would be dispensed with, as well as ten drivers, and in their stead one officer and four men, two engineers and two stokers would suffice. The steam engine is preferred to any other type of prime motor, as fuel for it is always accessible. It is proposed further that the steam engine for the motor vehicle should be utilizable for providing power for other purposes, notably for the working of cranes, for the placing of guns on embattlements, for the operating of pumps, and for the driving of dynamos for the generation of electricity to facilitate signaling and the lighting of camps, as well as for supplying current for electric motors for bread kneading, etc. The report estimated the introduction of 500 such engines into the German army would dispense with about 10,000 horses, and reduce the personnel from 5500 to 1000 machinists and 1000 firemen.

From *The Horseless Age*, Sept. 10, 1902.

Sealed Power is in this fight!

On the engine firing line as the global war rages are millions of Sealed Power piston rings, pistons, and cylinder sleeves. You'll find them in bombers, fighters, tanks, jeeps, motorcycles, mobile radio units, torpedo boats, tank landing boats, destroyers, submarines.

Sealed Power products in Diesel engines are saving fuel, saving oil, safeguarding bearings, journals, and cylinder walls on every front in our country's struggle for Victory.

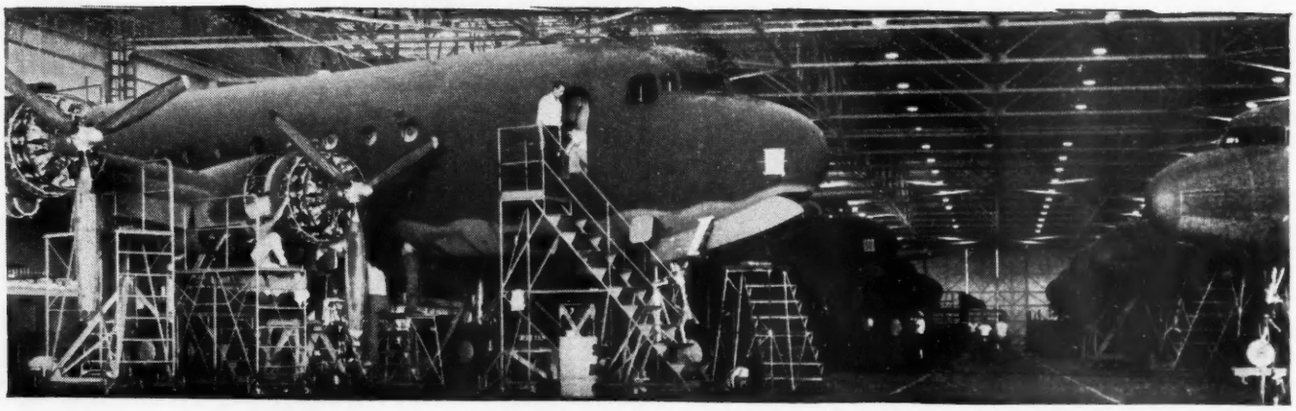
Engine manufacturers, car and truck manufacturers, plane builders, boat builders, repairmen, fleet operators, Army and Navy officers are invited to consult Sealed Power Engineers on any of their engine problems.

BUY WAR BONDS

SEALED POWER CORPORATION

Pistons, Piston Rings, Cylinder Sleeves for all types of internal combustion engines, pumps, compressors, etc.

Muskegon, Michigan • Windsor, Ontario



Douglas C-54 Production Line

Heralded as the largest transports in mass production, these C-54's, being assembled for the U. S. Army, have the capacity of a standard railroad boxcar.

5 Ways to Get Faster Deliveries of *Special* Carboloy Tools and Blanks

A "special" Carboloy tool or blank is one made to special shape, size, tolerance or grade. Any one or all of these requirements—means a "special". It requires special handling apart from our regular production line of standards. To help you get essential specials with a minimum of delay and expense, we list below 5 suggestions to follow when ordering.

BUT—before you order—check your needs against Carboloy Standard Tools & Blanks. Produced and placed in stock by the thousands daily, Carboloy Standards are suitable "as is"—or adaptable by grinding—to 80% of all turning, boring, facing jobs. In this crucial period when every minute counts, you can usually save 6 to 8 weeks delivery by ordering standards instead of specials whenever possible.

FIVE POINTS TO CHECK WHEN ORDERING "SPECIALS"

1. Follow these suggestions when specifying tolerances—

(a) Be *sure* your tolerances are as liberal as job will permit.
(b) Specify tolerances on all decimal dimensions.
(c) Use our standard tolerances whenever possible. These are:

STANDARD TOLERANCES

TOOLS			BLANKS	
Shank Width and Height	Finished Tools	Milled and Brazed Tools	Blank Dimensions	Tolerance
1" and less	+.000; −.010	+.000; −.015	Up to ¾".	+.015; −.000
Over 1".	+.000; −.015	+.000; −.015	⅞" to 1"	+.020; −.000
			1" to 2"	+.040; −.000
Shank Length:			2" to 3"	+.060; −.000
4½" and less	+ 1/16; − 1/8		3" to 4"	+.080; −.000
4⅝" to 7½".	+ 1/8; − 1/8		4" to 6"	+.100; −.000
Over 7½"	+ ¼; − ¼		Over 6"	+.125; −.000

2. Specify the following stock sizes of shank steels:

¼" square	⅝" square	¾" square	⅝" x 1¼"	1" x 1½"
5/16" square	½" x ¾"	⅝" x 1"	¾" x 1½"	1¼" x 1½"
⅜" square	¾" square	¾" x 1"	1" x 1¼"	1½" square
½" square	½" x 1"	1" square	1¼" square	1½" x 2"

3. Design tools to use standard blanks. They are carried in stock.

4. Use the same standard relief and rake angles that we use on our standard tools. Our manufacturing facilities are set up to produce these angles rapidly. (Send for catalog GT-142.)

5. Furnish at least two (preferably three) sets of blueprints on all special orders. This eliminates delays for duplications of prints.

CARBOLOY COMPANY, INC.
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Order "Specials" When They Are Essential . . .

BUT . . . whenever possible use Carboloy STANDARD tools and blanks . . HERE'S WHY:

Carboloy Standards are in "mass" production. Shipped from stock. No delays for drafting, quotations or special ordering. You save 6 to 8 weeks delivery time.

You can quickly and easily torch braze standard blanks to your steel shanks in your shop. . . Tool up rush jobs *FAST!*

You can quickly grind standard tools to special shapes. Carboloy standards are adaptable to 80% of all turning, boring, facing jobs.

CARBOLOY CEMENTED CARBIDES
TOOLS • DIES • DRESSERS
CORE BITS • MASONRY DRILLS
• WEAR RESISTANT PARTS •
FOR THE MANUFACTURING • MINING • TRANSPORTATION • CONSTRUCTION INDUSTRIES

Canadian Car and Foundry Builds Many Plane Types

The Canadian Car and Foundry Co., Ltd., has organized a large group of self-sustained plants throughout Canada for the production of aircraft and all of the necessary components and accessories.

As part of its program for the building of trainers, the company has converted its Amherst plant for the production of the Canadian version of the twin-engine Avro Anson; facilities are also available for the assembling and repair of the English Anson. Subassemblies are shipped from the Montreal plant.

In the mid-west, remote from coastal vulnerability, the Fort William plant of the company produces the Hawker Hurricane fighter, which is also assembled from parts produced within the environs of the company.

Through its own engineering division, the company has designed and completed an aircraft radial engine in the 180-hp. class for use in light training planes for the British Commonwealth Air Training Plan. A 3000-hp. fuel-oil-injection engine is under development.

In a separate plant in the vicinity of Montreal, the company produces aircraft propellers for use with engines within the 300 to 1100-hp. range. The propeller is a hydraulically controllable unit, with constant-speed and full-feathering features optional on all models.

In addition to these activities, the company has undertaken the construction of the American-designed Curtiss dive bomber.

Correction

In the description of the McKee wear gage on page 40 of the September 1 issue of AUTOMOTIVE AND AVIATION INDUSTRIES, the phrase reading "a maximum diameter of 2 7/32 in." should read "a *minimum* diameter of 2 7/32 in."

Continuous Mold Conveyors

many types—for every requirement

• Loaded as they pass the molder's station—then continuing past the pourers, along the cooling zone to the shakeout, and around again in an endless cycle—Bartlett-Snow Mold Conveyors provide foundry owners and managers with a means of securing a maximum of both quality and quantity from their plants.

With a continuous mold conveyor, sand can be reused three, four or more times a day. Flasks can be used over again eight to twelve times each shift. Output per given floor space is much increased. "Overhead" is spread over a larger production resulting in a less costly, more salable product.

Bartlett-Snow two wheeled single axle "cars" supported in part by the side rail of the next adjoining car, and four wheeled two axle cars—are available to meet a wide variety of size and weight requirements. Car tops can be fitted with gravity rolls if desired to facilitate the loading and removal of large heavy molds,—and cars with special tops, axles, wheels, etc., can be furnished to meet any requirement.

Our recently completed 44 page Foundry Bulletin No. 91 illustrates many different applications of mold conveyors and other Bartlett-Snow Foundry Equipment . . . No obligation . . . Send for a copy today.

100% War Bond Buyers
Average Payroll Deduction-14%
H. S. Hersey
PRESIDENT

THE C. O. BARTLETT & SNOW COMPANY
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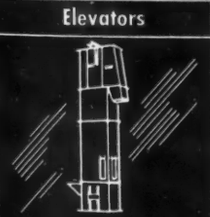
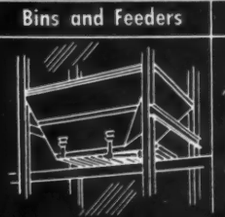
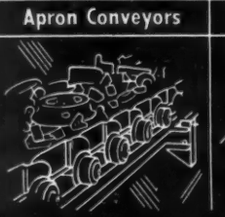
BARTLETT-SNOW

ENGINEERS AND FABRICATORS FOR THE FOUNDRY INDUSTRY

Complete Sand, Mold and Castings Handling Equipment for any requirement, including

Shakeouts	Elevators	Aerators	Sand Distributors	Bins and Feeders	Apron Conveyors	Dust Collectors
						

Westinghouse Steam Division Speeds Output

Construction has started at the Westinghouse Electric and Manufacturing Co. on three large steam turbine generators to provide power for America's new synthetic rubber industry.

The abundance of high-pressure steam required for the production of butadiene and styrene, principal constituents of Buna S rubber, will enable new chemical plants to generate their own electric power as a by-product. The steam will be used, first to drive the turbine generators and then in the chemical processes.

Form New Division

Recognizing the increasing demand for aluminum and magnesium castings and the rapid growth of those divisions of the foundry industry, the American Foundrymen's Association has divided its present Non-Ferrous Division to create a new Light Alloys Division. The present Non-Ferrous Division will become the Brass and Bronze Division.

ELASTIC STOP NUTS

THE RED LOCKING COLLAR ...IS A SYMBOL OF SECURITY

Greatly increased propelling energy and gun power, built into modern war equipment, call for bolted fastenings that can be depended upon to hold tight under any combination of vibration, stress, and shock load.

Already in use on all of America's military and transport airplanes, Elastic Stop Nuts were prepared for the job . . . and today there are more of these fast-gripping safeguards on your sky-fighters, tanks, Naval vessels, guns, and other war tools, than all other lock nuts combined.

CATALOG ON REQUEST

ELASTIC STOP NUT CORPORATION

Elastic Stop SELF-LOCKING NUTS AND AIRCRAFT FITTINGS

REG. U.S. PAT. OFF.

2339 VAUXHALL ROAD • UNION, NEW JERSEY

SAMPLE NUTS FOR TESTING

Books

(*Continued from page* 56)

transmissions the treatment is somewhat more general, the principles of operation being explained and the advantages and disadvantages of the different types pointed out. In a final chapter a large number of current designs of geared transmissions for use in all types of motor vehicles from scooters to railcars are illustrated and described. The following list of chapter heads will give a good idea of the scope and contents of the book:

Introduction; Friction Clutches; Automatic Clutches; Hydraulic Couplings; Over-running Clutches; Some Principles of Toothed Gearing; Sliding-Gear and Contant-Mesh Transmissions; Bearing Loads in Geared Transmissions; Planetary Transmissions; Electric Drive; Hydrostatic Transmissions; Hydro-Kinetic Torque Converters; Differential or Power-Shunt Transmissions; Inertia-Type Transmissions; Variable-Throw Transmissions; Automatic and Power-Controlled Stepped Transmissions; Pneumatic Transmissions; Geared Transmissions for Different Services.

* * *

PLANT PROTECTION, *by E. A. Schurman. Published by Cornell Maritime Press, 350 West 23rd St., New York, N. Y.*

Written by the chief of plant protection of the Glenn L. Martin Aircraft plants, this book describes the establishment, reorganization, and conduct of the modern plant protection department. The book is well illustrated and includes reproductions of office and control forms.

The manual is designed as a guide for the man who must institute adequate security measures against spying and sabotage. It contains an organization structure and operations plan suitable for a force of any size. It then takes up routine procedures, equipment, and methods. Chapters are included dealing with self-control, self-defense, and fire hazards.

* * *

WHY WE HAVE AUTOMOBILE ACCIDENTS, *by Harry R. DeSilva, research associate, Institute of Human Relations, Yale University. Published by John Wiley & Sons, Inc., New York, N. Y.*

The literature of highway accidents and highway safety is growing, and as long as road accidents continue at the rate of the last few years, a more intensive study of their causes and of means to reduce their frequency deserves encouragement. The automobile industry is greatly interested in reducing the number of accidents as much as possible. Designers have done their part by providing better brakes, better lights, and increased stability by widening the tread and lowering the center of gravity; they have also endeavored to increase the safety of their vehicles by submerging controls below the surface of the instrument panel, providing the back of the front seat with a safety roll, and by so shaping protuberances on the outside of the body that the clothing of people in the roadway cannot catch on them.

But besides automobile engineers many other groups are interested in traffic-accident prevention. Some of these groups are listed by the author in his Preface.

The book deals with the subject of highway accidents from every angle, largely on the basis of surveys made by different states and by safety organizations. Of most direct interest to the automobile engineer and executive is a chapter on "Making the Vehicle Safer."

The book covers the subject of automobile accidents and their prevention quite comprehensively and can be recommended to those actively engaged in the promotion of traffic safety. It concludes with a bibliography of 300 items.

EXCUSE US FOR POINTING

— but here's one bottleneck we know how to handle!

A cutting oil problem, especially these days, may develop into a nasty bottleneck. That means production slowed up, schedules delayed, and machinery idle. All in all, an extremely unpleasant experience for any wartime manufacturer.

We licked that problem long ago, not only in the laboratory, but under the severest conditions of day-to-day shop operation. That's why Cities Service can help you lick that problem with service-proved cutting oils engineered for your job by experienced lubrication technicians.

Why not get the benefit of our experience? We'll be glad to have a Cities Service lubrication engineer consult with you on the problems of your particular job. This service is yours for the asking. Just phone or write our office nearest you, today!

An informative booklet, "Metal Cutting Lubrication," is available to the personnel of cutting oil users. Simply fill out and mail the coupon below.

OIL IS AMMUNITION—USE IT WISELY!

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A LUBRICANT FOR EVERY INDUSTRIAL NEED

Publications

(*Continued from page* 54)

E. I. duPont deNemours & Co., contains a timely article, **Resistance to Effects of Flexing Is Important Design Consideration.***

Toledo Scale Co.'s line of **floor scales** are described in a new four-page leaflet just published. Well illustrated, the leaflet shows typical floor scale installations and cut-out sketches of structural features.*

The Hydraulic Press Mfg. Co. has issued two new booklets, No. 34 on **Hydraulic presses,** and Bulletin 4206 on **Fastraverse Metal Working Presses.***

Bear Mfg. Co. has just issued a catalog on **wheel aligning axle and frame straightening service.** It also describes the various Bear products and gives engineering and dimensional data which can be of much assistance to service shops when determining their requirements.*

* Obtainable through editorial department, AUTOMOTIVE *and* AVIATION INDUSTRIES. Address: Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

William N. Albee

William N. Albee, formerly advertising counsel for several divisions of General Motors Corp. from 1916 to 1925, died late last month after a long illness at his home in Detroit.

Announce Plan For Solvent Saving

A program for reclamation of millions of gallons of war-essential chemical solvents and oils has been announced by the Conservation Division of the War Production Board.

Solvents which can be reclaimed include a wide variety of chemicals such as alcohols, chlorinated compounds, esters, ethers, hydrocarbons, and ketones. Under these general classifications are innumerable specific products including benzol needed to make synthetic rubber, toluol which goes into TNT, naptha, gasoline, and other compounds used in industrial plants.

PHOTO BY U.S. ARMY SIGNAL CORPS.
MORE THAN 41,000,000
STERLING PISTONS...
have been giving unsurpassed service in hundreds of thousands of America's best known internal combustion engines, including bus, truck, passenger car, tank, airplane, and marine engines. An inherent desire to do the best possible job plus the experience of building 41,000,000 pistons has given Sterling engineers the ability to design pistons that get the most power and stamina from an engine.
A simple request will bring you the services of an experienced Sterling engineer.
STERLING ALUMINUM PRODUCTS
Incorporated
St. Louis, Mo.
LETS GO! U.S.A.
KEEP 'EM ROLLING
STERLING
PISTONS

MEN

(*Continued from page* 52)

the Cleveland office of the Worthington Pump and Machinery Corp.

Richard W. Palmer has resigned as vice-president of engineering at Vultee Aircraft, Inc. Succeeding Palmer is **A. P. Fontaine,** chief of engineering and development at Vultee.

Robert Miller has been elected vice-president and secretary, and **Edward V. Carlson,** treasurer of Menasco Manufacturing Co.

William R. Robbins has been appointed division accountant and **James R. Seaman** assistant treasurer of the Pratt & Whitney Aircraft Division of United Aircraft Corp. **Frederick C. Detweiler** has been named division accountant and assistant secretary and **George Knaus** assistant treasurer of the United Aircraft Corp. of Missouri, which will operate a new plant at Kansas City.

William R. Odell, Jr., formerly assistant treasurer of International Harvester Co., has joined the staff of the Chicago Ordnance District, where he will serve as assistant to the head of the contract service division.

Members of the new board of directors of the Breeze Corps., Inc., are: **David T. Wilentz,** attorney general of New Jersey; **John T. Mascuch,** a brother of Joseph J. Mascuch, founder of the company; **Temple N. Joyce, J. F. Lucas,** vice-president and sales manager; **Frank Y. McLaughlin, C. K. Pistell,** and **Fred G. Shupp.**

Yellow Truck & Coach Mfg. Co. has elected six new directors: **Charles T. Fisher,** president of Fisher & Co.; **Walter L. McLucas,** board chairman of the National Bank of Detroit; **George Carter,** president of the Detroit Insurance Agency; **R. J. Emmert, C. O. Ball,** and **W. B. Livingston,** vice-presidents of Yellow Truck. Directors who have resigned due to added responsibilities in the war effort are: **C. E. Wilson, O. E. Hunt, Albert Bradley, R. H. Grant,** and **C. L. McCuen,** all officers of General Motors, and **George A. Green,** a member of the government Lease-Lend staff in London.

Sherrod E. Skinner, vice-president of General Motors and general manager of the Oldsmobile Division, has taken a leave of abesence to serve as director of the production division of the Army's Services of Supply. During his absence **David E. Ralston,** executive assistant, will serve as acting general manager.

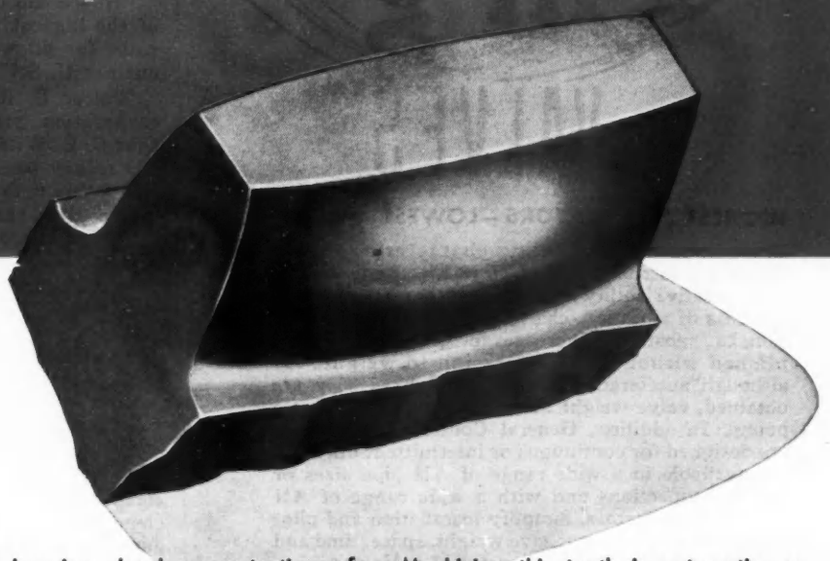
Maj.-Gen. Charles M. Wesson, former chief of ordnance who retired May 31, has been appointed assistant to **E. R. Stettinius, Jr.,** Lease-Lend administrator.

Howard S. Welch, former executive vice-president of American Eastern Corp., has been elected president and a director of Eisemann Magneto Corp., New York City.

Frank A. Sharpe has been named sales manager of Midwest Abrasive Co.

THE ELLIPTOID TOOTH FORM

Eliminates End Bearing—Solves Difficult Aircraft, Military & Naval Gear Problems



End bearing—load concentration of gear teeth at one end or the other—has always been a source of gear noise and early failure. In conventional gear practice it can be avoided only by extremely close tolerances—difficult and costly to maintain and which retard production rate.

Gear teeth given the Elliptoid Tooth Form on the Red Ring Rotary Gear Shaving Machine avoid end bearing. The Elliptoid tooth is thinner at the ends—thicker at the center or where-ever it is desired to locate the bearing.

Machining this tooth is automatic—a patented optional part of the shaving operation—adds nothing to the very low cost of shaving.

With this method, smaller, less costly gears will stand up better under the same loading. For example, Elliptoid gear replaces conventional bull gear increasing service life 400%. When used in same aircraft gearing, service life was increased 200%—in truck transmission it provided an increase of 300% in service life. Similar records made in many other cases.

Write for descriptive bulletins.

SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

NATIONAL BROACH AND MACHINE CO.

RED RING PRODUCTS

5600 ST. JEAN · DETROIT, MICH.

SIMPLIFY

do it electrically

with

GENERAL CONTROLS

hi-g

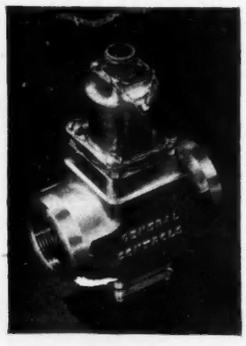
TRADE MARK

VALVES

HIGHEST "g" FACTORS—LOWEST WEIGHT

Most important operating characteristic of all General Controls Aircraft Type Electric Valves is their positive ability to operate in any position, regardless of vibration, change of motion or acceleration, i.e., substantial increases in "g." This is accomplished without any concession to weight; for although acceleration factors as high as 300g are obtained, valve weight may only be a fraction of a pound. In addition, General Controls hi-g Valves are designed for continuous or intermittent duty and are available in a wide range of AN pipe sizes or tubing connections and with a wide range of AN electrical connectors. Simplify installation and pilot supervisory operations; save weight, space, time and money—specify General Control hi-g Valves.

Available for handling all fluids, gases and vapors, up to 1500 lbs. or more, in normally closed, normally open, single seated, pilot piston operated and 3- or 4-way selector valve types. Ask for descriptive Bulletin.



SAFETY SHUT-OFF for GASOLINE OR OIL

(Type AV-12 at Left)

These valves are of the packless, semi-balanced or single-seated, metal seated type. Available normally open or normally closed; require current only to close or open. Avoid vapor lock. Operate on DC, 6 to 24 volts. Handle either oil or gasoline.

GENERAL CONTROLS

PIONEERS AND LEADERS IN THE DEVELOPMENT AND MANUFACTURE OF MAGNETIC VALVES

801 ALLEN AVENUE, GLENDALE, CALIFORNIA

BOSTON • NEW YORK • PHILADELPHIA • DETROIT

CHICAGO • CLEVELAND • DALLAS • SAN FRANCISCO

War Plants Report

(*Continued from page* 49)

cludes 0.4 cents for overtime, 3 cents for the overlap arrangement by which machinery is kept running during lunch periods and the employes paid for this time, 3 cents for the added night shift premium raised from 5 to 10 per cent, and 1.3 cents for higher vacation pay. Anderson argued that the average weekly earnings of GM employes increased $13 per week, or 32 per cent, from January, 1941, to May, 1942, while the cost of living rose only 15 per cent. However, this included overtime and the panel only considered straight time earnings.

In recommending the 3½-cent per hr raise (included in the straight time 5-cent boost) to equalize GM wages with those of Ford plants, Anderson contended that the comparison was made between Ford aircraft plants in the Detroit area and the average for more than 90 GM plants located in 39 communities.

"How could the WLB defend ordering GM to match each of the highest Ford rates and not order those same wage rates for all workmen in every other war plant throughout the U. S.?" asked Anderson.

Walter E. Reuther, UAW-CIO vice-president, charged corporation profits were skyrocketing and pointed out that C. E. Wilson, GM president, had been granted a $50,000 salary boost and an $80,000 bonus in 1941. He compared this with the average pay of $2,153 for GM workers in the same year.

On the profits question, Anderson asserted that the average percentage profit of GM before taxes on war production is substantially half of what it was able to make in a competitive peace-time market. This means that the 400,000 owners of the corporation will receive approximately one-half of the return they have received in recent years, with reduced dividend checks so far totaling $1.50 per share compared to $2.75 for the same period last year.

Anderson opposed the maintenance of membership clause recommended by the panel because GM maintained that it was inconsistent with the Wagner Act and that compulsory unionism results in loss of discipline, inefficiency of operations, increased costs and reduced war production. Reuther, asking for the more rigid union shop, said it would permit the union to pass from the organizational to the administrative stage and enable union leaders to build high morale and fully mobilize the men behind the war effort. He charged that corporation policies were made in New York and not in the GM plants. As a result of existing conditions, Reuther said there is more unrest in the automobile industry than at any time since 1937, year of the sitdown strikes.

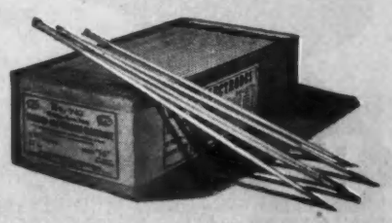
After the hearing the WLB gave no indication of the eventual decision in the case. In the dispute between Ford and the UAW-CIO, terms of a proposed new contract, with the exception of wages, have been referred to the membership of Ford Local 500 for ratification. A three-man WLB panel previously had conducted hearings. The wage issue will be submitted to the WLB for decision.

A wildcat strike closed the new Buick aluminum foundry, making aircraft engine parts, for two days and resulted in the suspension of four employes from work by the U. S. Army pending investigation of their status. One of those suspended is Edmund Geiger, a member of the Buick seven-man shop committee and a current candidate for the Flint city council. The walkout in the core-making department was precipitated by the discharge of two 18-year-old workers who the management said were incompetent but the union charged Buick with a speed-up on piecework operations. Two officers of the union appeared in the picket line and they were suspended on the basis that they had pledged uninterrupted production by this war plant. The Chevrolet transmission plant at Saginaw also had a one-day wildcat strike caused by dissatisfaction with grievance procedure.

CO., INC.

FOR ALL-POSITION WELDING OF THIN METAL AND LIGHT SECTIONS

Ideal for the aircraft industry is Wilson 520. With it, a smooth welding bead invariably results. Has excellent operating characteristics when used for a.c. or d.c. welding. Spatter loss is exceedingly low.



Set Up New-Car Maintenance Procedure

A broad program for the maintenance of the 500,000 passenger cars and commercial vehicles now frozen in the hands of producers, dealers, distributors, and other agencies has been announced by the heads of four Government departments vitally concerned with wartime transportation problems.

The program, which does not affect the ordinary car or truck owner, sets up 18 maintenance operations to be followed in caring properly for stored vehicles.

These operations include washing all vehicles, moth-proofing upholstery, draining engine oil and gasoline tanks, removing spark plugs, sealing engines to avoid damage from air moisture, removing and storing batteries, draining cooling systems, and jacking up vehicles to take the weight off tires.

Requisitioning powers of the War Production Board may be resorted to if it is found that the mechanical condition of any vehicle has been impaired or will become impaired due to failure to comply with these maintenance standards.

Two orders, WPB Conservation Order M-216 and OPA Amendment No. 4 to Revised Price Schedule No. 85 have been issued to implement the program, which is designed to assure that all passenger and commercial vehicles now in storage awaiting rationing are kept in good condition.

Permits Limited Output

Authority to manufacture an aggregate of 4000 heavy trucks of a gross vehicle weight of 16,000 lb or more has been granted by the Director General for Operations to 15 producers in order to replace vehicles withdrawn from the civilian stockpile since June 1 by the Army, Navy, and Lend-Lease Administration.

Trucks produced under the authorization (Supplementary Limitation Order L-1-H) must be held for rationing under General Conservation Order M-100. The authorization expires Dec. 31, 1942.

Transfer Office

The executive sales office of the Columbia Chemical Division of the Pittsburgh Plate Glass Co. has been moved to Pittsburgh from New York. Also involved in the transfer are the chemical division's traffic and advertising departments.

The Potez 161

(*Continued from page* 48)

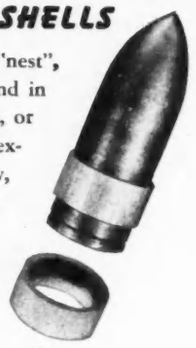
10 in.; length, 106 ft, and height, 27 ft 4 in. Component parts were built at the Potez factory of the S.N.C.A.N. system, which was formed in 1936 under the Law for the Nationalization of Military Industries in France, comprising the Potez, C.A.M.S., Amiot, Mureaux and Breguet companies. When the Potez factory turned to all-out war production in September, 1939, the subassemblies were sent to Le Havre and the flying boat completed there.

Two other flying boats, the Marshall Petain and Admiral Lartigue, were completed recently at the Latecoere Aircraft Works. They have a cantilever wing and tail unit and retractable wing tip floats. Maximum speed is given as 220 mph, cruising speed 160 to 175 mph, and range 3770 miles with a headwind of 37 mph. Other specifications follow: span, 188 ft 6 in.; length, 154 ft 5 in.; wing area, 3770 sq ft; empty weight, 81,600 lb; gross weight, from 145,500 to 154,300 lb; wing loading, 38.7 to 40.9 lb per sq ft; power loading, 15 to 16 lb per hp. Each is powered by six Wright Cyclone engines rated at 1600 hp for take-off.

High Speed Automatic
SHELL-BANDING MACHINE

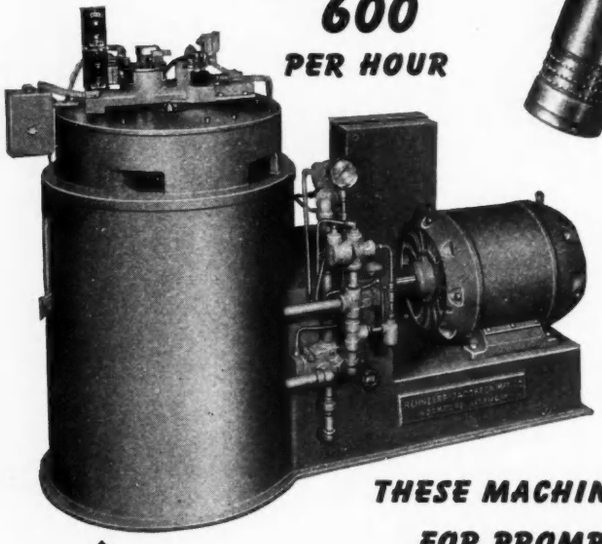
FOR 20 MM. TO 75 MM. A. P. OR H. E. SHELLS

Operator drops shell and band into the "nest", presses a button, the machine squeezes the band in place and ejects automatically. One, two, three, or four squeezes can be selected, with automatic indexing between squeezes to permit uniform metal flow, prevent crystallization of the copper, and provide thorough penetration into the serrations. First stroke, when two or more are used, is a partial squeeze to flow the ring to top of serrations. Pressure can be closely regulated to suit a variety of conditions. Production obtainable depends on the efficiency of the operator in loading. Cycle of one stroke is 1½ secs.



CAPACITY - 37 MM. SHELLS
600
PER HOUR

20 MM. SHELLS
1200
PER HOUR



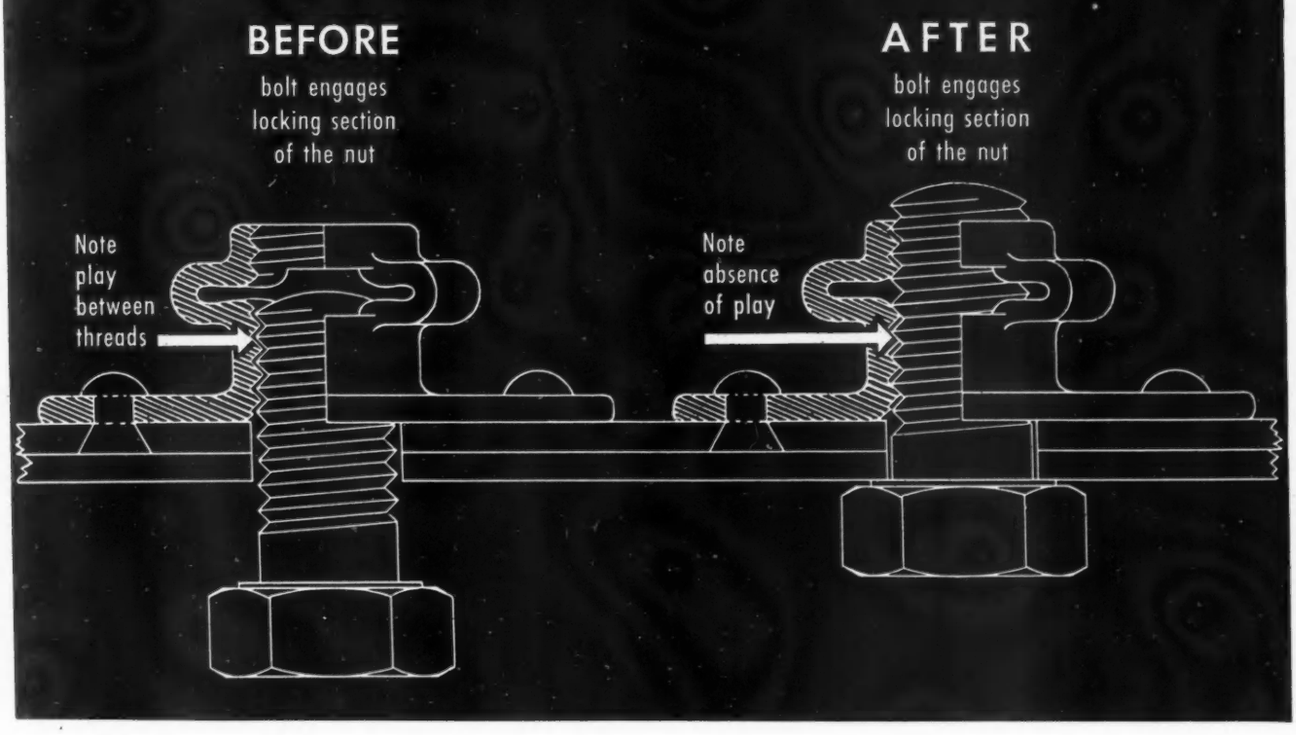
The R-J Shell-Banding machine is hydraulically operated with electric controls. It will handle all sizes of projectiles from 20 mm. to and including 75 mm. size, either armor-piercing or high-explosive types. It can be changed over from one size to another in less than 15 minutes. Equipped with a 10 h.p. motor and takes floor space of 36" x 72".

THESE MACHINES AVAILABLE FOR PROMPT DELIVERY

REHNBERG R-J JACOBSON

REHNBERG-JACOBSON MFG. CO.
Special Machinery
2137 KISHWAUKEE ST. • ROCKFORD, ILLINOIS

HERE'S HOW BOOTS SELF-LOCKING NUTS INSURE VIBRATION-PROOF CONNECTIONS


BEFORE
bolt engages locking section of the nut
Note play between threads
AFTER
bolt engages locking section of the nut
Note absence of play

CONSTANT PRESSURE CONTACT ELIMINATES AXIAL PLAY

The Boots Self-Locking Nut is a one-piece all-metal nut which withstands the severest vibration. Essentially two nuts in one, the top (locking) section is displaced in a downward direction so that its locking threads are out of lead with the load carrying threads of the lower section. The two sections are connected by a spring member, which is an integral part of the nut.

Upon the insertion of a bolt, the spring member, because of its elasticity, allows the top section of the nut to be extended to engage properly with the threads of the bolt. A constant force is thus established which locks the nut firmly into position without damage to the threads of nut or bolt. Axial thread play is eliminated.

BOOTS NUTS SAVE UP TO 60 LBS. PER PLANE, DEPENDING ON MODEL

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In addition to the important and substantial weight-saving characteristic, Boots Nuts have another outstanding advantage: they are all-metal, which means they may be used over and over again with continuing self-locking efficiency. Boots Nuts "Outlast the Plane."

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BOOTS AIRCRAFT NUT CORPORATION

GENERAL OFFICES, NEW CANAAN, CONNECTICUT

Michigan Leads in Major War Contracts

(*Continued from page* 17)

Indicating that the machine tool industry is nearing the peak of its capacity, consistent with the raw materials available, shipments of such units in July exceeded June by only 2 per cent. July deliveries of 28,300 new machine tools were valued at $113,600,000 compared to June shipments of 26,600 units valued at $111,100,000. However, July deliveries showed a 96 per cent gain over the same month of 1941. With the tooling stage for war production now well along, the machine tool output is beginning to level off.

Because the machine tool industry has such a huge backlog of orders, the Ternstedt Mfg. Division of Fisher Body undertook to build its own boring machines for work on an order for high caliber anti-aircraft guns. As normal sources could not supply the machines in less than 18 months, Ternstedt engineers took it over and now 25 machines have been built and are turning out the gun's upper carriage ahead of schedule.

The machines are a unique adaptation of single purpose equipment for multiple duties. Each machine is now doing work for which two or three machines ordinarily are needed and one special set-up of seven machines is doing the work that 46 to 52 ordinary machines could do on the same job. The work is so tooled that two and sometimes three boring heads work on a single part simultaneously, saving many hours in operating and fixture setting time. The machines also are adapted to perform varied operations, such as boring, facing and milling. In one case a boring head is used for drilling operations, then the same head is employed for circular facing on the same fixture set-up. The machines have been built with an up-and-down traverse and horizontal mobility to allow them to do multiple work on a single job set-up. All this is being done in a Ternstedt plant that formerly produced garnish molding for Fisher bodies. Gun parts weighing more than half a ton are being produced in a plant which formerly contained polishing and spraying machinery, lacquer ovens and rolling mills for automobile hardware and trim.

Continental Motors Corp., which recently received the Army-Navy "E" as the first volume producer of tank engines, is now producing more of these radial type engines in a month than it did in the first six months of production. Four days' current output exceeds an original month's schedule. Continental also has taken over a plant of the Guiberson Diesel Engine Co. at Dallas to manufacture parts for medium tank engines. Guiberson had been scheduled to produce a radial diesel engine for tank propulsion in the Dallas plant, which was completed last spring with Defense Plant Corp. funds. Continental took over the Dallas plant Sept. 1 on a lease basis and will retool sections of it to produce the tank engine parts. Output should be under way by the end of September, according to C. J. Reese, Continental president. Continental also operates plants at Detroit and Muskegon and is building a new plant for aircraft engine manufacture.

The Texas bomber assembly plant operated by Consolidated Aircraft Corp., which puts together B-24 subassemblies shipped by the Ford Motor Co., has changed over to transport planes to meet the urgent need for air cargo carriers. First of the transport versions of the B-24 has come off the Texas assembly line a month ahead of schedule. Maj.-Gen. H. H. Arnold, chief of the Army Air Forces, recently told a Senate committee that 21 per cent of the production of multi-engined military planes in the second half of 1942 would consist of transport and cargo types, while in the first half of 1943 this proportion would rise to 32 per cent.

(*Turn to page* 74, *please*)

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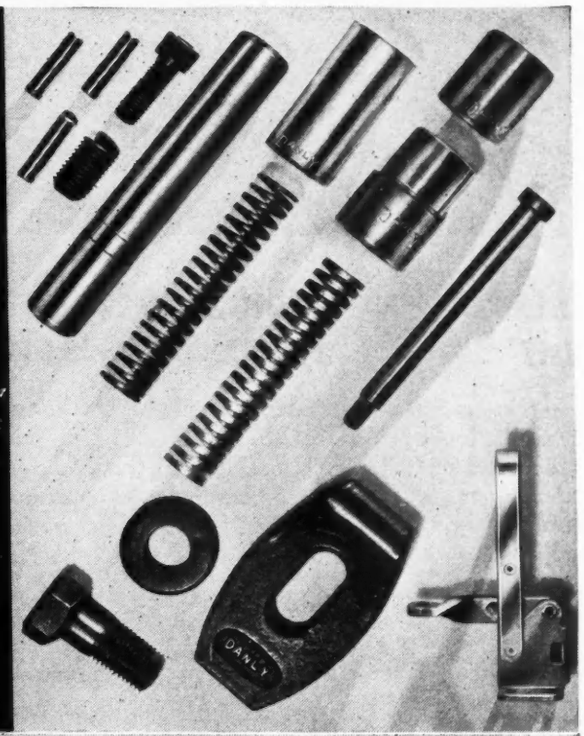

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Plant Distribution Systems

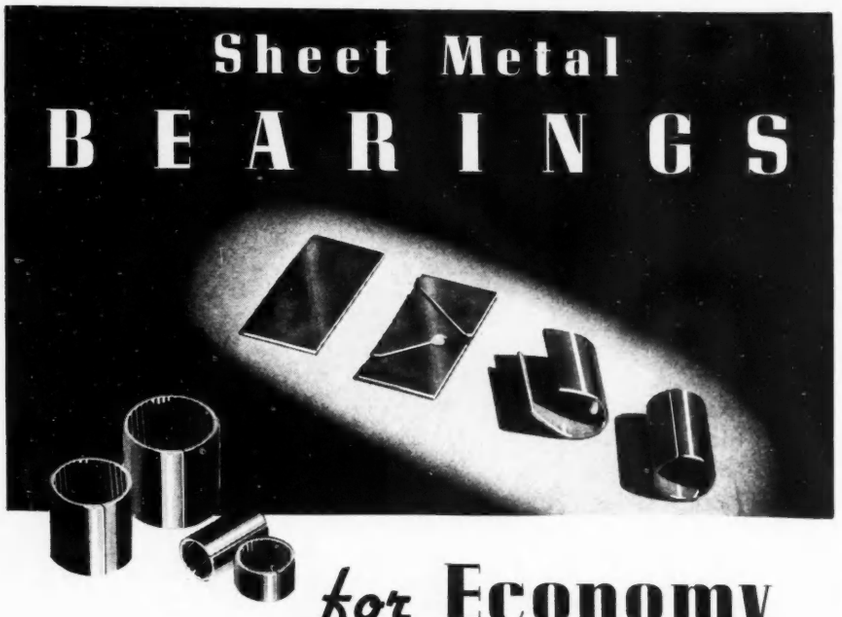
(*Continued from page* 70)

Meanwhile, the first fighter plane ever assembled by General Motors Corp. came off the assembly line of the new Eastern Aircraft Division at Linden, N. J. This plane, a carrier-based Grumman fighter for the Navy, was assembled from parts furnished by Grumman and was an educational model to try out and check the jigs, fixtures and assembly line at the Linden plant. The plane passed a successful test flight.

With aircraft output constantly expanding, the WPB announced that five important magnesium plants have entered production in recent weeks, providing much needed magnesium for airplane engine and airframe manufacture. One of these foundries was built by the Ford Motor Co. The others are Basic Magnesium, Inc., plant in Nevada, the largest magnesium plant in the world; the Dow Chemical Co. plant in Texas; the Permanente Metals Co. plant in California, and the New England Mine Co. plant in Connecticut. All were financed by the Defense Plant Corp.

As scrap metal, especially scrap iron, is urgently needed in the war production program, the Salvage and Conservation Committee of the Automotive Council for War Production announced that 115,000 tons of metal scrap had been collected by automotive plants in July. Fifteen thousand tons, or 13½ per cent of the total, was dormant scrap compared to only 9½ per cent dormant scrap in June. Dormant scrap contrasts with scrap from productive operations. The July scrap total consisted of 109,000 tons of iron and steel, 2136 tons of aluminium, 3253 tons of copper and brass and 756 tons of other non-ferrous metals. A total of 839 tons of scrap rubber also were collected. Meanwhile, automobile graveyards yielded 434,448 tons of iron and steel scrap in July, according to WPB, bringing the total for four months to 1,633,369 tons. This compares with a 1941 monthly average of 150,000 tons.

Sheet Metal
BEARINGS



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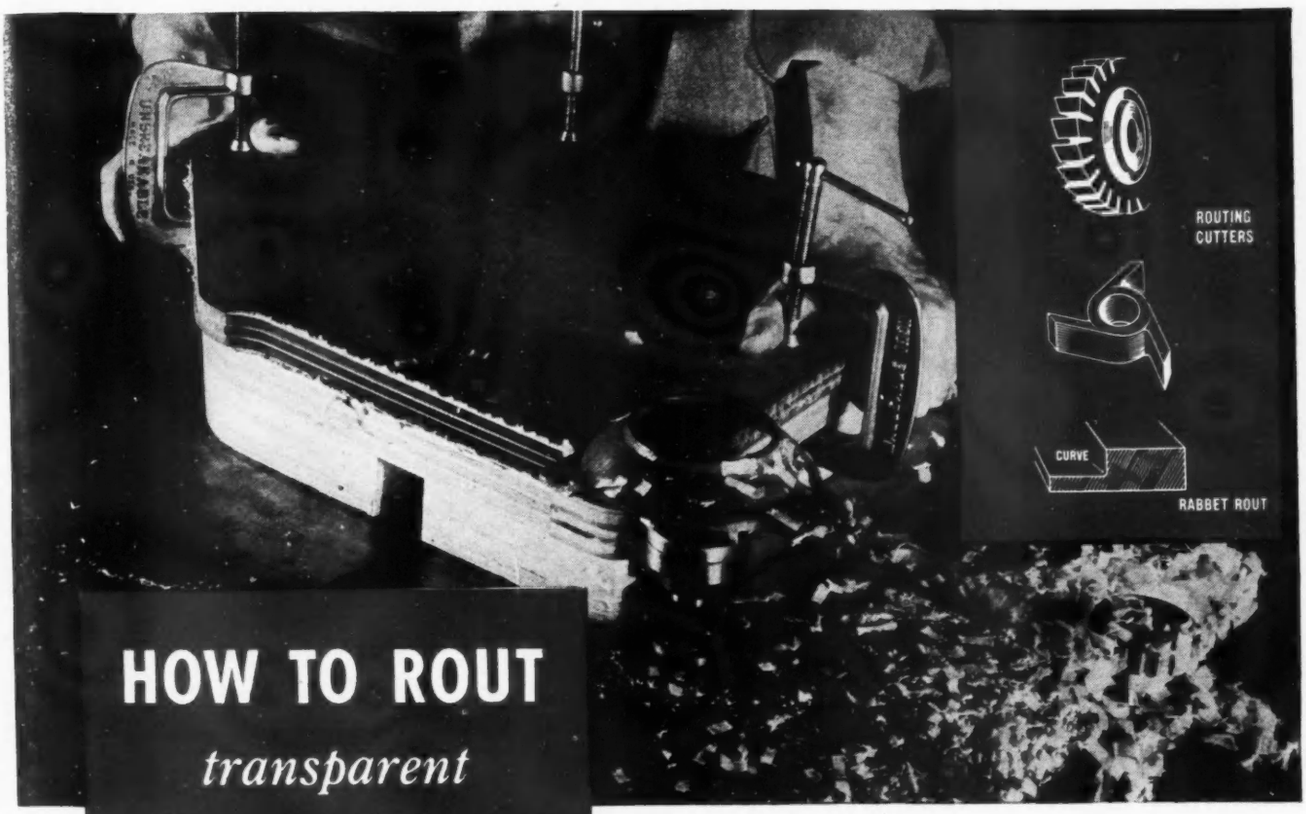
Heliarc Welding

(*Continued from page* 41)

the electrode. The tungsten electrode varies in size from 1/16 in. to ¼ in., depending upon the thickness of metal welded and the heat required. To obtain maximum benefit from the helium as an oxidation preventer, the torch must be held as close to the weld as possible. Also, an arc length of 0.060 in. maximum should be maintained. Poor penetration or gas holes may result by using too long an arc. For alloys that have a tendency to be hot-short, a high welding speed is recommended, approximately 3 fpm, to eliminate the danger of cracking.

A conventional arc-welding machine with direct-current generator of 150-amp output is desirable. However, larger machines with outputs not exceeding 300 amp may be used, provided the current output can be controlled. An upright machine is preferable, because a helium tank can be attached to it more easily. Separate amperage and voltage regulators must be provided, and the machines should have a continuous sequence of five increments of current control. The average life of a 200-cu ft helium tank is about 35 hr of continuous welding with a medium-sized torch. Fairly pure helium gas is required. Helium as purchased from the Government plant is normally sufficiently pure to cause no difficulty. Contaminating gases in helium, such as carbon dioxide, hydrogen, nitrogen and the hydrocarbons, may cause pronounced defects. Hydrogen produces porosity. Oxygen "films" the metal, causing poor coalescence and inclusions. When there is as much as 7 per cent nitrogen in the helium, the welding speed is about one-third less than when the nitrogen content is only 2 per cent. All of these gases, if present, may be removed by passing the helium through filtering media.

This method of arc-welding has provided an important new tool for the fabrication of structures from alloys such as magnesium and stainless steel.



HOW TO ROUT *transparent Du Pont "Lucite"*

Information for aircraft manufacturers and their established enclosure suppliers

TOUGH, crystal-clear Du Pont "Lucite" methyl methacrylate resin is used by a majority of plane manufacturers for transparent enclosures. This light weight, weather-resistant plastic may be machined with standard hand and power-driven equipment.

Routing is a customary method of machining transparent sheeting. For contour and step routing, vertical-spindle wood shapers give excellent results. Portable hand routers have worked successfully in trimming edges of sheets and for surface routing.

SLOW, EVEN FEEDING. It is best to feed "Lucite" slowly to the cutter. The plastic should be held firmly with the hands or in a convenient jig. A small bite should be taken to prevent chipping and cracking and the piece should be moved continuously to avoid burning and gumming.

CUTTER BLADES AND SPEEDS. Standard two-bladed wood cutters are good for high-speed portable routers. Two-, three-, and even multiple-blade cutters can be used on vertical spindle shapers. Six- to ten-bladed cutters at 6,700 rpm. are best for square routing or shaping "Lucite". With two- to three-bladed cutters, speed should be from 7,000-15,000 rpm. Cutters up to 3" in diameter are used for "Lucite".

For special cross-sections, use cutters ground to these shapes. Rib shapes can be made by routing strips of "Lucite" in the same way wood molding is produced. Only sharp cutters should be used, ground with about a 10° back clearance angle. The rake angle should be from 20-30°.

FOR RABBET OR STEPPED ROUTES. Back off the cutting teeth on the underside to prevent a drag on the upper surface of the toe. Otherwise the plastic will be burned. Grind the corners of the routing cutters to at least a 1/16" radius, so as to produce a fillet at bottom of the route and thus add strength to the piece. Because, in step routing, an edge of the "Lucite" bears on a collar as a guide, the collar should be well greased to prevent frictional heat and burning.

COOLING. If work is done carefully, cooling is seldom necessary. In the few instances where a coolant is necessary, water is the best. An air blast or suction system will remove chips and help cool the cutter.

FINISHING. The edges of the "Lucite" sheet, as a rule, do not require finishing. But the worked surface may be made clear by polishing. Edges may be beveled by using a router with cutters ground at the proper angle, by inclining the sheet and using a straight edged cutter or by use of a tilting spindle router.

Practically all leading airplane plants are using Du Pont "Lucite" in their airplane enclosures because of its clarity, weather-resistance, light weight and strength. Du Pont also manufactures "Plastacele" cellulose acetate transparent sheeting for light plane, glider and trainer enclosures. Ask Du Pont for assistance on questions of forming or fabricating transparent enclosures. E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J. . . . and 5801 South Broadway, Los Angeles, Cal.

DU PONT REG. U. S. PAT. OFF. "LUCITE" REG. U. S. PAT. OFF.

METHYL METHACRYLATE RESIN

Any type of joint which has been commonly used for welding ferrous metals, may be employed on magnesium and stainless steel.

Heretofore stainless steel has been the most difficult alloy to weld; it could be satisfactorily arc-welded only by the use of atomic hydrogen, and then only in thicker sections. By the heliarc welding process, thicknesses of less than 0.010 in. may be easily welded. When stabilized stainless steel is heliarc-welded, carbide precipitation is very low, as compared to the precipitation with other methods of welding, which greatly increases its fatigue factor.

In the heliarc-welding of magnesium structures, the polarity of the tungsten electrode is reversed, which makes the magnesium the anode. For ferrous and copper alloys, a carbon electrode is used and the welded structure is the cathode. Craters are eliminated in reverse-polarity welding.

Heliarc welding has proved successful with heat-resisting alloys of high melting point. It is claimed to give the greatest penetration of any known welding process. The Dow Chemical Co. also has done development work on the process, and a paper on its metallurgical aspects is scheduled for presentation by a representative of that company at the annual meeting of the American Welding Society at Detroit in October.

Production at the Willys Plant

(*Continued from page* 25)

Denver; have the recess cut for the copper band; press on the band; machine the band, etc. The thread for the nose piece is cut in Lees-Bradner thread millers.

This is decidedly a mass production set-up with mechanization and automaticity wherever feasible. Thus, for example, all inter-machine movement of the work is facilitated by the installation of Logan gravity roller conveyors. At the machines the work is lifted and toted by means of the versatile M-M-M Budgit hoists. Interdepartmental hauling is done with Yale & Towne industrial trucks of various types and capacities.

In addition to the machine shop equipment, this department features a large battery of Thomson-Gibb resistance welding machines which are employed for the seam-welding attachment of the steel disk on the closed end of the shell body. These machines, as well as the smaller units used on the smaller shell, use two welding rollers for the seam welding operation.

Following completion of the machining operations, the shells are routed to the paint department where they are painted in one of two colors identifying the type of shell—i. e., whether H.E. or gas-filled. Here the paint is sprayed by hand in DeVilbiss booths designed for the purpose. It is of interest to find that the shell bodies are moved to the paint spray booths on Logan gravity roller conveyors which are fitted with soft rubber rollers to prevent mechanical damage in handling.

Other machine shops in the plant make parts for the little Jeep engine and have retained their identity without change from the prewar set-up. Among these are the machine shop lines for the crankshaft, for the camshaft, for water pumps, and for other engine parts fabricated in this plant.

That is a brief picture of the situation at the moment. Suffice it to say that the Willys operation is in a state of flux and future expansion on war production should convert it to one of the most important units in the automotive industry.

Issue Recommendations

Printed copies of Simplified Practice Recommendation R6-42, Files and Rasps, are now available, according to an announcement of the Division of Simplified Practice, National Bureau of Standards.

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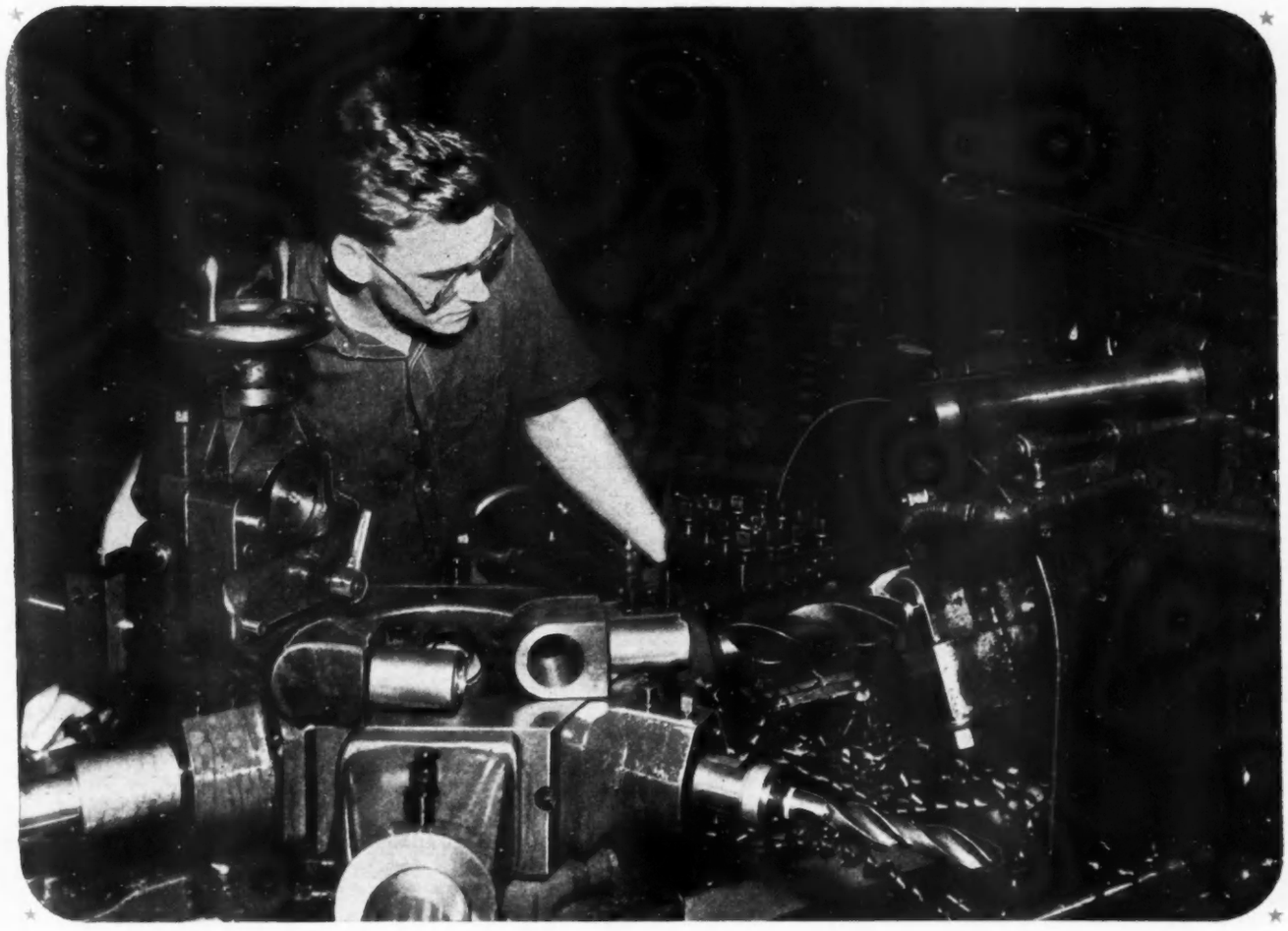

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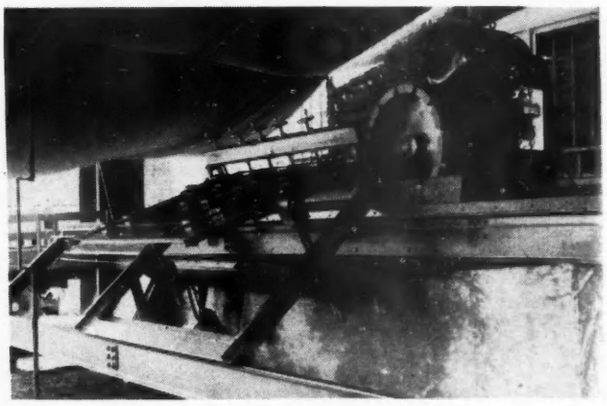
MEN and MACHINES

(*Continued from page 47*)

A NEW gear finishing machine, incorporating the crossed-axis principle of gear shaving, has been developed by Michigan Tool Co., Detroit, Mich.

The machine, model 861--4B, is specially designed for finishing gears less than 4 in. in diameter and less than 1 in. in width. It is consequently particularly suitable for the production of gears for instruments, control mechanisms, and similar precision devices.

Designed for mass production, the new machine is automatic in operation.



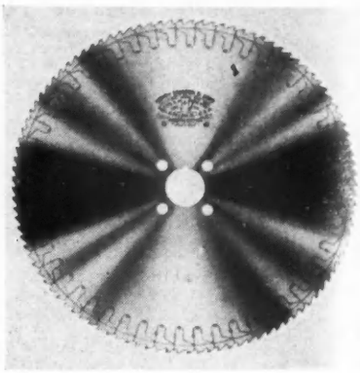
Vonnegut LG armor plate edge grinder.

THE Vonnegut LG type armor plate edge grinder, built by the Vonnegut Moulder Corp., Indianapolis, Ind., has been specifically designed to speed war production.

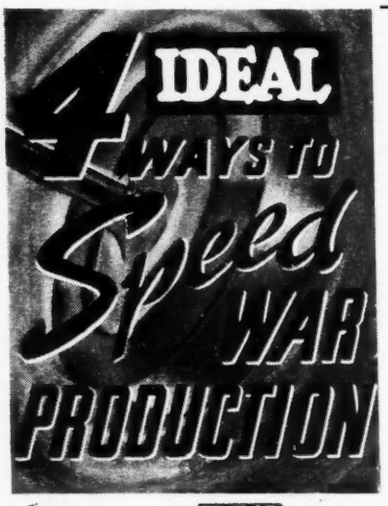
Consisting of a stationary grinder unit and two adjustable-angle traveling work tables, the grinder is provided with a 36-in. abrasive wheel supported on a 6-in. spindle driven by a 40-hp motor. The two work tables are adjusted by means of heavy screws to produce bevels ranging from 90 to 25 deg. Although the machine is designed so that one table can be in operation while the other is being loaded or unloaded, it is possible to couple both tables to the cable drive to handle larger plates.

The tables are attached or disconnected from the driving cable, powered by a 3-hp motor, by means of several quick-acting clamps. A 1-hp motor drives the coolant pump.

IN the modification of certain 75-mm shells for a revised nose fitting, it was found that tap and chaser life was exceedingly short. Investigation showed



This new metal-cutting saw, manufactured by Henry Disston & Sons, Philadelphia, Pa., is said to combine the advantages of an inserted-tooth and a solid-tooth saw. Provided with inserted sections rather than inserted teeth, the saw cuts a narrower kerf and can be operated at speeds up to 5000 rpm.



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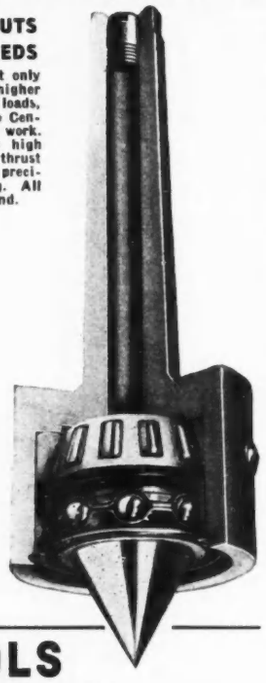

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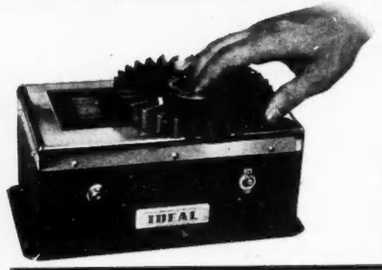
ELECTRIC ETCHERS
Permanently mark iron, steel and their alloys. New, "Machine Shop" model has 14 etching heats. Other models for fine or heavy duty etching.



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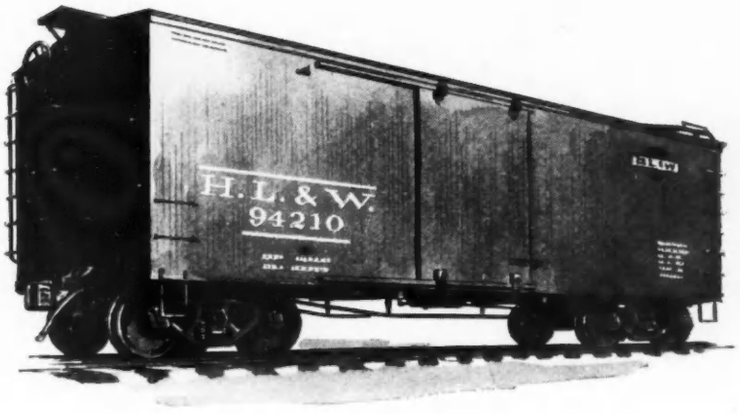

How to Fill Box Cars with Fuel Oil

THE Mareng cell for transporting fuel oil by rail is a huge collapsible synthetic rubber container that holds 2250 gallons. Six Mareng cells installed in a box car transform the car into a rolling tanker capable of hauling approximately 50 per cent more fuel oil than the average cylindrical tank car. On arrival at their destination, the cells can be collapsed into small bundles and shipped back for refilling.

As a means of getting fuel oil to factories and homes that may this winter be lacking it because of the shortage of oil transport facilities, the Mareng cell is currently receiving intensive tests. The Association of American Railroads and Government officials recently inspected a successful test unit which rolled into Washington from "Somewhere in Indiana."

The Mareng cell — so called for the Glenn L. Martin Company which holds patents on the device — is fabricated of Thiokol* synthetic rubber by the U. S. Rubber Co. Heavy duck covered inside and out with layers of Thiokol* synthetic rubber gives the cell complete resistance to fuel oil, to moisture, and necessary flexibility and strength.

Have you in mind applications for Thiokol* synthetic rubber which will help us win the war faster? For over thirteen years we have been cooperating with companies using various Thiokol* types for hose, linings, molded parts, and many other industrial products. Our experience is yours for the asking.

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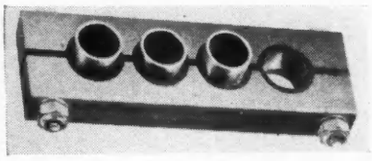
that the trouble was caused by the presence of hardened shot from a shot-blasting operation. In order to relieve this condition it was found necessary to heat the inside of the nose to annealing temperature without any change in the physical characteristic of the shell.

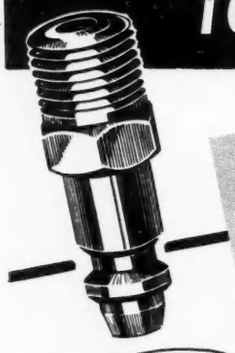
This difficulty was overcome by using a Model 1070 Thermonic induction generator built by the Induction Heating Corp., New York, N. Y., which is fitted with specially designed coils. A production rate of 280 units per hr is said to have been achieved.



The research department of Adel Precision Products Corp., Burbank, Cal., has developed this new line support which contains only a fraction of the synthetic rubber material used in the production of standard 800-A supports. It is available in many types and sizes.

WHETHER IT'S PRODUCTION TO MEET...

WAR DEMANDS OR COMPETITION



HANSEN Push-Tite AIR HOSE COUPLINGS WILL DELIVER

They're faster, far more economical, no wastage of air, easier to operate, no leakage from an ounce of pressure up to well over 14,000 pounds, longer life, trouble free operation. Slight push of plug into socket it is connected absolutely air tight, air is automatically turned on. There is no turning of air valve, connection or hose. Easy pull back on sleeve and plug is ejected, disconnected and air is automatically turned off. Is it any wonder they're the talk of the trade and the choice of most of the big industrial plants thruout the country. SEND FOR FREE CATALOG.

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Pierce Governor War Problems

(*Continued from page* 39)

character of the machinery and tooling. These serve our purpose better than any word picture of the operation.

It is of interest to find that even under the circumstances, the plant management has found it feasible to take advantage of the unique properties of cemented-carbide tools in certain specific instances. Carboloy-tipped tools are employed to a considerable extent on screw machines and in the drill press department, being used both on cast iron and on steel. Even in this limited operation, Carboloy has stepped up productivity and has increased tool life, with a corresponding decrease in tool set-up changeover.

The pictorial section shows a corner of the Parkerizing department which has been installed recently to take care of the increasing demand for protection against corrosion. Another interesting development is the introduction of a compact heat treating department, employing exclusively E. F. Houghton's Perliton liquid carburizing bath. The plant has an excellent metallurgical laboratory—a rarity in most small plants—and the metallurgist has assigned the following reasons for his adoption of the Perliton method:

1. Bath strength easy to maintain.
2. Powder on the floor stays dry—making it safe to walk.
3. Bath can be used for light (0.03 in.) or deep (0.05 in.) penetration without adding energizers.
4. Bath strength easy to check.
5. Low cost equipment will handle this type of carburizing set-up.
6. Faster than using the "box method" for case hardening.
7. By proper supervision the maintenance is low.
8. Bath liquid shields work from air at the working temperatures, quenches well in water.
9. Bath also excellent for treating tool steels.

Apart from the introduction of some new inspection equipment and a general tightening up of inspection procedure, quality control is about the same as in the past. To provide some impression of the extent to which mechanical governors are employed, we have reproduced a table giving some of the current applications of Pierce governors.

Move Project To New Laboratory

The first use of The Minta Martin Aeronautical Laboratory for research has been made by the U. S. Weather Bureau. Major Lester D. Gardner, executive vice president of the Institute of Aeronautical Sciences, announced that an important research project had been transferred from Washington to Daniel Guggenheim Park, Port Washington, Long Island.